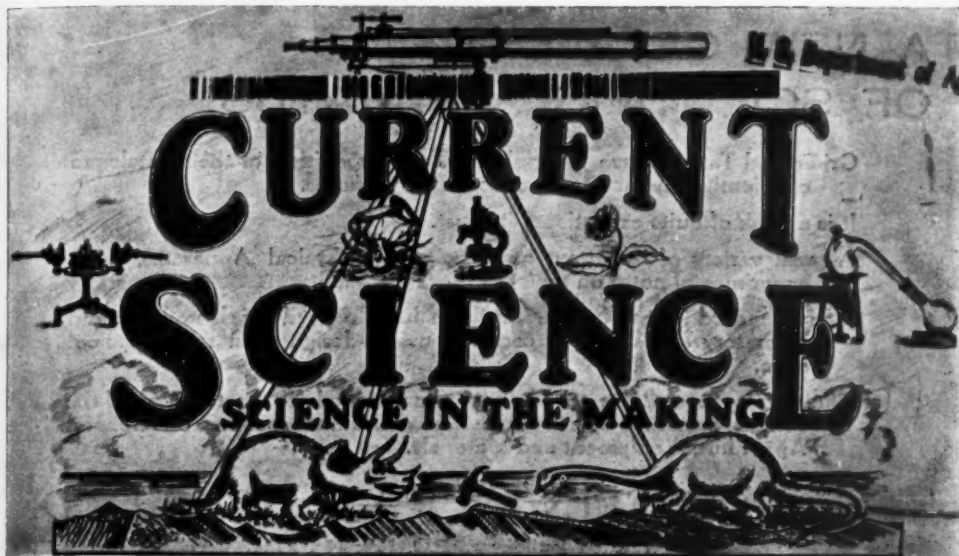


RECEIVED
DEC 26 1934



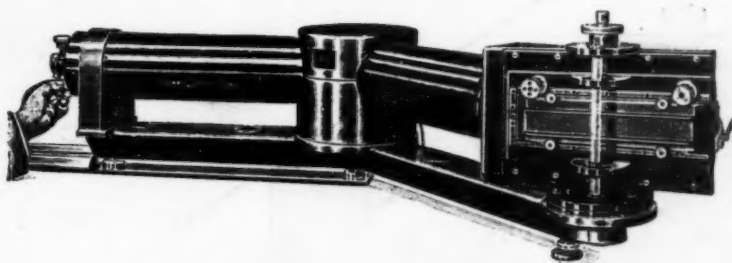
Vol. III

NOVEMBER 1934

[No. 5]

A ZEISS MASTERPIECE

THE NEW HIGH DISPERSION QUARTZ SPECTROGRAPH



FOR PLATES OF 24:6 CM. SIZE

WILL BE EXHIBITED AT THE SCIENCE CONGRESS EXHIBITION IN CALCUTTA

SOLE AGENTS

ADAIR, DUTT & Co., LTD.
CALCUTTA — BOMBAY — MADRAS

□ A NEW CATALOGUE OF SCIENTIFIC APPARATUS

Griffin and Tatlock have just published a new edition of their Catalogue of Scientific Apparatus for educational purposes.

It is a book of quite exceptional interest.

A great variety of important new designs in Physical Apparatus, with experimental notes on their uses, are included.

Many standard forms of apparatus have been revised for this edition and laboratory appliances in common use re-designed in more efficient form.

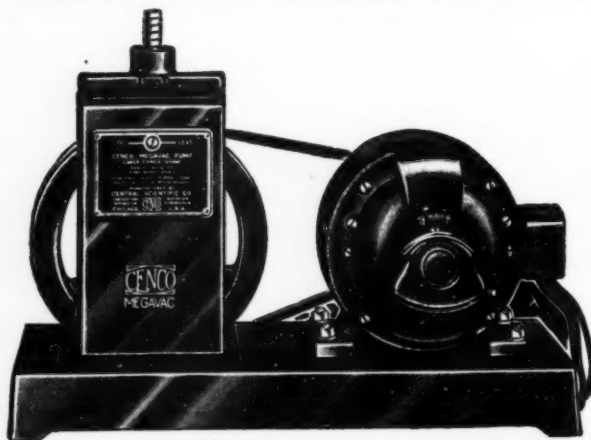
The Catalogue contains all the apparatus needed for the teaching of the various branches of Physics with substantial sections on General Apparatus, Equipment and Materials.

GRIFFIN & TATLOCK, LTD.

B5 Clive Buildings, P.O. Box No. 2136, CALCUTTA

LONDON	GLASGOW	MANCHESTER	EDINBURGH	LIVERPOOL
Kemble St., W.C. 2	45 Renfrew St., C. 2	34 Gt. Ducie St., 3	7 Teviot Place, 1	164 Brownlow Hill, 3

CENTRAL SCIENTIFIC COMPANY'S



HYVAC PUMPS

MEGAVAC PUMPS

HYPERVAC PUMPS

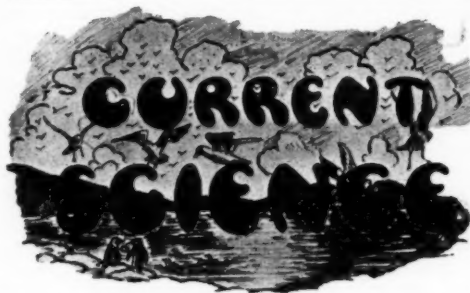
*Full Particulars from the
Sole Agents:*

THE SCIENTIFIC INSTRUMENT Co., LTD.

**5-A, ALBERT ROAD
ALLAHABAD**

**240, HORNBY ROAD
BOMBAY**

**11, ESPLANADE EAST
CALCUTTA**



Vol. III] NOVEMBER 1934 [No. 5

CONTENTS.

	PAGE
Sir James Jeans and the New Physics ..	181
The Stratosphere Balloon and its Use in Scientific Research. By K. R. R. ..	183
Some Recent Advances in Indian Geology. By W. D. West ..	185
Observations on Some Plant Abnormalities in Bengal. By K. Biswas, M.A. ..	189
The Role of Silicon in Plant Nutrition. By A. Sreenivasan, M.A. ..	193
Obituary :	
Dewan Bahadur K. Rangachari, M.A., L.T. ..	197
V. Krishna Murti Iyer, G.M.V.C., L.V.S. ..	198
Sir Arthur Schuster ..	198
Letters to the Editor :	
Ground-absorption of Wireless Waves and the Electrical Conductivity of the Earth. By S. R. Khastgir ..	199
The Arc Spectrum of Selenium. By K. R. Rao and S. G. Krishnamurti ..	200
An X-Ray Investigation of the Crystals of M-Azotoluene. By M. Prasad and P. H. Dalal ..	200
Vitamin C in Indian Food-Stuffs. By B. C. Guha and A. R. Ghosh ..	201
A Note on the Changes in the Physical and Chemical Characteristics of the Blood Sera of Opium Addicts. By R. N. Chopra and S. N. Mukherji ..	201
Apple Rot caused by <i>Fusarium moniliforme</i> Sheldon. By Anil Mitra ..	202
Dichotomous Branching in the Leaves of <i>Pleopeltis simplex</i> Sw. By S. R. Kashyap and P. N. Mehra ..	203
Pollen Sterility in <i>Zeuzine sulcata</i> (Lindley). By K. N. Seshagiriiah ..	205
A Peculiar Cotton Plant. By Mohammad Afzal ..	206
On the Trematode Infections in Certain Indian Fishes. By M. Rahimullah and B. K. Das ..	206
Dispersal of Gall Mites by Gall Midges. By M. S. Mani ..	208
Agricultural Education in India. By "One Practical Fellow" ..	208
Research Notes ..	210
Dipole Moments. By M. A. Govinda Rau ..	215
Industrial Possibilities of Some Research Work done in India. By B. N. S. ..	218
Science Notes ..	219
Reviews ..	223
Errata ..	226
Reviews of Books (Supplement) ..	i-xii

[All rights reserved.]

Sir James Jeans and the New Physics.

THE Presidential Address of Sir James Jeans before the British Association is a fascinating piece of work. Most of it is taken up with a presentation of those aspects of modern physics which have influenced modern scientific outlook—as envisaged by Jeans. In the first place, he makes a clear-cut distinction between the methods of the classical physicist and of his modern successor. The former was keen on trying to construct a mental picture whose elements were derived from objects of every-day experience such as 'billiard balls, jellies and spinning tops'. It is because of this tendency on the part of the 'old-fashioned' physicist to visualise a concrete model in his explanation of phenomena, that classical theories or modifications of such theories on classical lines could not be made to embrace the new facts of observation. According to Jeans the changed outlook of the modern physicist consists in the following:—The content of a set of physical measurements is a set of numbers, each number being a ratio. For instance, to take an example given by Jeans, when we say that the wave-length of a certain radiation is so many centimetres we mean that it is a certain multiple of a centimetre, and since we do not know or rather can never know what a centimetre is in itself, the significant fact in the statement 'so many centimetres' is only its numerical part. Once we concede this, it naturally follows that our theoretical picture of the phenomenal world, which consists in synthesising measured data must be mathematical in form.

The solid rock on which the modern physicist builds is ascertained fact and the bricks used in the construction are the 'observables'. For instance, in the wave theory of light, the solid fact is represented by the word 'wave', and the ether with which the classical physicist filled space, space itself and time, are man-made decorations and do not form part of nature. The same is the lot of the space-time continuum of the theory of relativity, for the General Theory shows that it 'can be crumpled and twisted and warped as much as we please without becoming one whit less true to nature—which of course can only mean that it is not itself part of nature'. The entire knowledge of the outer world comes to our minds through the

frame-work of space and time and their product the space-time continuum, as it affects the senses. However important the frame-works may be, they do not form part of nature but are purely mental constructs. The same is the fate of matter. It is as much a pure assumption as ether and is an 'unobservable'. Classical Physics was based on the hypothesis that matter existed in space and that its history was mechanistically determined for all time, time being independent and objective. The cardinal weakness in this outlook of the classical physicist was that the rôle given to the mind was that of a passive onlooker without any influence on what it observed. According to Jeans, what the modern physicist has set before himself is the task of studying the impressions that he gets through 'the gateways of knowledge' (*i.e.*, the senses) and not what lies beyond. He is concerned with appearance rather than with reality. In ordering these impressions he adopts two pictorial methods. In one he pictures particles in space and time, in the other, the picture is a system of waves; the former provides for our bias inherited from Classical Physics, while the latter is intended to provide an answer to the question 'what is going to happen next?' Jeans dubs the two modes of looking at the physical world, (which world, as he has already told us, consists only in the impressions which we get through the senses) parables, to prepare us for any inconsistency that may turn out to exist between the two pictures, for parables are not to be interpreted too literally. The thesis is developed on these lines with illustrations from the findings of modern physics, the several parts of the thesis often being not in perfect harmony with one another. The burden of the song may be summed up in the words of Jeans himself: 'The old physics imagined it was studying an objective nature which had its own existence independently of the mind which perceived it, which indeed had existed from all eternity whether it was perceived or not.' But in the new physics nature consists of waves and these are of the general quality of waves of knowledge, or of absence of knowledge in our minds.

To those who are familiar with the writings of Jeans the distinctly subjective trend which he gives to the findings of modern Physics will not appear strange. He says, "If we ask the new Physics to specify an

electron for us, it does not give us a mathematical specification of an objective electron but rather retorts with the question, 'How much do you know about the electron in question?' We state all we know, and then comes the surprising reply, 'that is the electron'. Here the electron itself is not part of nature and our knowledge of it ultimately resolves itself into a set of numbers synthesised into one or more mathematical formulæ. The numbers themselves are ratios of physical quantities incomprehensible in themselves. Thus it turns out that our knowledge of the electron in the 'parable' is purely mathematical, nay, more, this mathematical content of our knowledge is the electron. The modern physicist's knowledge of nature is, according to Jeans, to be identified with the mathematical formulæ which he constructs from physical measurements. The question naturally arises whether the earth, sun, moon and stars which the ordinary man thinks exist in space and time, have any existence apart from the respective mental impressions. The answer to this question would be in the negative if we interpret literally the following thesis in the address: 'The earthquake waves which damage our houses travel along the surface of the ground, but we have no right to assume that they originate on the surface of the ground; we know on the contrary that they originate deep down in the earth's interior.' Applying the analogy, the sensory impressions which we have of familiar things do not have their origin, as we think they have, in the sun, moon and stars, which we think we see, but somewhere else, presumably in the mind itself. But if this be so, the main objection to subjective idealism arises, *viz.*, how is it that all of us see the same sun, moon and stars? To this difficulty Jeans suggests an answer. In the particle picture we think of individual particles, electrons and so on, existing in space and time; as far as we know, in the truer wave picture, the individuality of the particles is lost. As we think ourselves to be existing in space and time we retain our individuality, but if we transcend space and time we perhaps form parts of a single stream of life, where apparently individuality is lost. "It is only a step from this," says Jeans, "to a solution of the problem which would have commended itself to many philosophers, from Plato to Berkeley, and is, I think, directly in line with the new world-picture of modern Physics." It is no

doubt true this is only a suggestion, but is the suggestion in the right direction and does it naturally lead to Berkeley's Subjective Idealism? To Berkeley the objects of every-day observation on examination turn out to be ideas in the perceiver's mind. For an object to exist is to be perceived. In order to account for the sameness of the objects perceived by a number of observers Berkeley introduced the hypothesis of God in whose mind all objects exist as ideas and our ideas are replicas, so to speak, of the ideas in the mind of God. If we take away God whose existence Berkeley assumed, the difficulty that all of us see the same sun and moon remains unexplained. Moreover to Berkeley individual personalities were not indistinguishable ingredients of a stream of life, as is the case with the electrons in an electron current. In fact, no satisfactory answer to the fundamental difficulty which one encounters in all forms of extreme subjective idealism, has yet been offered by any philosopher; neither does modern Physics indicate a satisfactory way of meeting it. To Sankara, the famous Indian philosopher, both our perceptions and the things perceived are illusory appearances spread over an unchanging

underlying reality. Our perceptions have no higher degree of reality than the things perceived. So in his system the idea that all persons see the same objects is in the mind and therefore is itself illusory.

'The old physics,' says Jeans, 'imagined it was studying an objective nature which had its own existence independently of the mind which perceived it which indeed had existed from all eternity whether it was perceived or not.' One would infer from this that there is no objective world existing independently of the perceiving mind. How different from this attitude is the view of Max Planck—one of the most prominent among the makers of modern physics! Says Planck: "A science that starts off by predicting the denial of objectivity has already passed sentence on itself." According to Planck one of the fundamental theorems of physical science is that there is a real world which exists independently of our act of knowing. So the reader of Jeans' fascinating address must not forget that there are prominent physicists who differ fundamentally from him on the philosophical implications of the revolutionary changes that have taken place in the domain of Physical Science.

The Stratosphere Balloon and its Use in Scientific Research.

THE investigation of the free atmosphere by means of sounding balloons carrying self-registering instruments has established that the mixing of the atmosphere due to convective processes extends on the average to a height of about 17 km. near the tropics and to about 9 km. near the poles. Above these levels, the atmosphere is extremely stable for vertical movements, the temperature increasing with height near the tropics and remaining more or less stationary up to 25 km. in temperate and polar regions. The upper stably layered region of the atmosphere is called the stratosphere. The temperature at the base of the stratosphere is about -80°C . near the equator and about -50°C . near the poles.

Among the great scientific achievements of the present decade must be included the stratosphere balloon ascents of the Belgian scientist Professor Piccard and his collaborators. The principal motive for Professor Piccard's adventure was the study of cosmic radiation more thoroughly and precisely

than was considered possible by other methods. The repetition of these ascents in other lands with similar balloons and technique and extended programmes shows that voyages into the stratosphere for scientific research have come to stay and that it is only a question of time before power-driven commercial machines will fly through the clear, cloudless air of the stratosphere with speeds not far short of that of sound.

Piccard's own account of the bold and successful flights carried out by himself and his colleagues is contained in his very interesting book *Auf 16,000 Meter-Meine Fahrten in die Stratosphäre* (Schweizer Aero-Revue, Zürich). The essential new feature of Piccard's flying equipment was the substitution in place of an open cabin of an air-tight gondola for the accommodation of the aviators and their measuring instruments. The gondola was spherical in shape, made of aluminium and had a diameter of 2.1 metres. It was provided

with two man-holes and eight small windows through which the balloonists could obtain a view of the outside world. For the regeneration of the used-up air inside the cabin, arrangements were made to let into the cabin out of a compressed oxygen cylinder two litres of gas per minute and to remove, by absorption in alkali, the carbon dioxide produced by the respiration of the passengers. The aviators could thus practically carry their own atmosphere with them and avoid all physiological difficulties due to the low pressure at the higher altitudes. With a view to regulating the temperature of the air inside the cabin, Piccard painted one half-side of the gondola black, leaving the other half bright. By means of a propeller actuated by an electric motor, he planned to turn the balloon round a vertical axis so as to expose either side of the gondola towards the sun. Unfortunately, during the first flight, the arrangement did not work and the gondola had its dark half facing the sun throughout the morning so that the temperature inside got uncomfortably high 25-34°C., although the outside temperature was -55°C. In the second ascent, the gondola was painted white and the result was that the temperature did not rise above 0°C!

The volume of Piccard's balloon, when fully inflated, was about 14,000 cubic metres and when full of hydrogen at a height of 16 km. (where the pressure is about 1/10 of that at the earth's surface) could sustain a total weight of 2100 kg. At starting, it was filled only to a fifth of its capacity.

Piccard and his collaborators carried in their balloons experimental equipment for measuring the intensity of cosmic rays both from the current produced in an ionisation chamber and from the enumeration of discharges in a Geiger counter. They also carried apparatus for measuring the effect of screening on ionisation and for determining

whether there was any directional variation of the intensity of radiation. The intensity measurements confirmed in general the results obtained by Regener from his sounding balloon experiments carried out a few days before Piccard's second flight. Both investigations showed that above 13-14 km. the rate of increase of intensity of cosmic radiation decreases with height and the intensity tends to reach a constant value at the outer limits of our atmosphere or even to show a decrease. The experiments with the Geiger counter showed that there was no appreciable variation of the intensity with direction. It would take us too far to discuss the significance of the cosmic ray measurements here.

Piccard's ascents were followed by the ascents of "Stratostat U.S.S.R." from Moscow in September 1933. This reached a height of 18,500 metres. Another remarkable ascent was organised in the United States of America in connection with the *Century of Progress* Exposition in November 1933. Professor Piccard collaborated in it. The balloon reached a height of 18,665 metres. Besides experiments on cosmic rays, measurements were also attempted with varying degrees of success on the transmission of the atmosphere for the solar spectrum with a quartz spectrograph, on the colour and polarisation of sky-light, on the photographic visibility of the earth using ordinary and infra-red light, on the intensity, range and freedom from static of radio signals transmitted from great heights, on the viability of spores exposed to conditions prevailing in the stratosphere, etc. The detailed scientific results of the ascents will be awaited with eagerness by workers all over the world.*

K. R. R.

* A. H. Compton, "Scientific Work in the *Century of Progress*: Stratosphere Balloon," *Proc. Nat. Acad. Sci.*, 1934, 20, 70.

Some Recent Advances in Indian Geology.*

By W. D. West,

Geological Survey of India.

2. Deccan Trap Volcanic Activity.

IN India we have one of the best developments extant of the 'plateau basalt' type of igneous activity, known as the Deccan Trap. The importance of a thorough study of these rocks will readily be appreciated when it is understood that in the opinion of many geologists the basalt, which is the predominant type in this series of rocks, is probably the primitive rock from which most other rock types have been evolved by some process of differentiation. The remarkable similarity in chemical composition which all plateau basalts throughout the world exhibit suggests that they have been derived directly from some primitive source without the intervention of any process of differentiation, and their study is, therefore, of great importance in relation to several branches of geology. So far, considering the very great area which these lavas cover in India, the extent to which they have been studied in detail is lamentably small. Their study is conveniently divided into two sections. On the one hand we have the immense thickness of horizontally bedded basalts and dolerites which make up the greater part of the Deccan Trap, and which are typical 'plateau basalts'. These show, even in detail, great uniformity of character, though certain slight differences in chemical composition can be discerned between the earlier and later outpourings. On the other hand, there occur certain areas along the north-west corner of the Deccan Trap outcrop, notably in Gujerat, Kathiawar and Cutch, in which differentiation has proceeded along special lines to an advanced stage giving rise to a great variety of rock types. It is essential for a complete understanding of either of these groups that both should be studied.

The most important contribution to our understanding of the petrography of the rocks of the former category has been provided by Dr. L. L. Fermor, whose study of the lavas penetrated by a deep boring at Bhusawal, some 250 miles north-east of Bombay, has provided us with an accurate

statement of the petrography of these rocks.¹ In a study of the 29 flows penetrated, it is shown that the predominant type of rock is a basalt or dolerite of specific gravity 2.91, consisting essentially of labradorite feldspar ($Ab_1 An_2$), enstatite-augite (pigeonite), iron ore and glass, while olivine, always completely altered, occurs in 18 out of 29 flows. This description may be regarded as typical of the greater portion of the flows of the Deccan Trap of India. In this paper particular attention is paid to the minerals of late crystallisation, occurring either as linings and infillings to the amygdaloids of the flows, or as alteration products of the glassy base and of some of the minerals. To the former group belong the minerals chlorophæite, delessite, chalcedony, opal, quartz and lussatite, and the zeolites heulandite, apophyllite and ptilolite, with calcite; while to the other group belong palagonite, chlorophæite, celadonite, chabazite, together with iddingsite, delessite and serpentine which are pseudomorphous after the olivine. The conclusion is reached that, with the possible exception of the calcite, these minerals have been formed during a late stage in the final consolidation of the lavas, and have not been deposited by meteoric waters. This is the first time these minerals of late crystallisation have been adequately described. Both in this and in subsequent papers the process known as 'palagonitisation' is discussed in detail,² a subject which also receives attention in a paper by D. N. Wadia.³ Finally, a further point brought out by Dr. Fermor is that in a number of the flows the olivine, and sometimes the labradorite, phenocrysts have sunk to the base of flows which were apparently more fluid than the rest at the time of eruption. This observation of the sinking of the crystals leads the author to suggest that the ultrabasic rocks found occasionally in the Deccan Trap, such as in Baluchistan, may have originated by some such mode of gravity differentiation, a point which is referred to again below.

¹ *Rec. Geol. Surv. Ind.*, 1925, 53, 93.

² *Op. cit.*, 1928, 60, 411; and *Geol. Mag.*, 1931, 68, 266.

³ *Rec. Geol. Surv. Ind.*, 1925, 53, 338.

* Published with the permission of the Director, Geological Survey of India.

In 1916 Drs. L. L. Fermor and C. S. Fox published an account of the Deccan Trap lava flows near Linga in the Chhindwara district, Central Provinces, with a map showing the distribution of five separate flows. Specimens representing four of these flows have now been analysed and the results discussed by Dr. Fermor.⁴ Although of the four specimens analysed two are basalts and two are dolerites, the analyses are all very similar. It is only when the norms are calculated that slight differences are brought out. These show that from the lowest to the highest flow the direction of change is increasing alkaline feldspars, increasing total feldspars, and increasing total pyroxenes, with decreasing total iron ores. When compared with the norm of the eleven analyses of Deccan Trap made by Washington, after arranging these latter into their probable order of extrusion, it is found that the differences in composition as one ascends in the Traps is similar in direction but much larger in degree than that shown by the four specimens. From this it is deduced that the tendency to differentiation illustrated by the lavas of Linga on a small scale is an epitome of that generally applicable to the lavas of the Deccan Trap series as a whole.

As regards the field relations of these plateau basalts and their associated dykes and sills, a good deal of work has recently been done by H. Crookshank along the northern slopes of the Satpura hills, in the north Chhindwara and south Narsinghpur districts, where both the field relations and the petrology of these rocks present many features of interest. A memoir on this area is shortly to be expected. The chief interest of the area concerns the abundant intrusive sills and dykes. Generally speaking, the high ground to the south and east of the area is occupied by Deccan Trap, and the low ground to the north and west by Upper Gondwana rocks. And although the sills are found to some extent in the southern area intruded between the basalt flows, they attain their grandest development in the Upper Gondwanas. The dykes are frequently composite and vary from fine-grained basalts to coarse-grained porphyritic dolerites. The sills are only very rarely composite, and are nearly all coarse-grained somewhat porphyritic dolerites. Normally the minerals of these rocks are the same

as those described by Dr. Fermor from Bhusawal, but there are also interesting variations. The sills, which are frequently several hundred feet thick, show well the phenomenon of the sinking of the olivine crystals, though not of the labradorite. In some cases not only has olivine sunk but a crypto-crystalline residue, representing the last part of the magma to consolidate, is concentrated in the upper parts of the sills. This latter contains primary quartz and micropegmatite. Quartz cannot of course crystallise in the presence of olivine; but the removal of olivine by sinking has evidently allowed crystallisation to proceed along lines favouring the formation of quartz, and the observation is of more than local interest. In one or two cases biotite was found partially altered to chlorophane, and Mr. Crookshank suggests that this mineral may once have been more abundant, but has in most cases been destroyed by the palagonitisation. One dyke, which has been traced intermittently for eight miles, deserves special mention. It is a porphyrite consisting of oligoclase, quartz, enstatite, augite, hornblende and micropegmatite, with an SiO_2 percentage of 63. Nothing like it has hitherto been noted in the Central Provinces.

Coming now to the second portion of our subject, we have to deal with a large variety of rock types, some very basic, some very acid, and others markedly alkaline, which are found mainly in the peninsula of Kathiawar and the adjacent country. These rocks are definitely part of the Deccan Trap volcanic episode, but represent the results of advanced differentiation localised about certain areas or along certain lines. Ever since the days of F. Fedden⁵ it has been realised that the peninsula of Kathiawar was exceptional in containing several foci of eruption in which differentiation had proceeded to yield a large variety of rocks. So long ago as 1893 Dr. J. W. Evans made a collection of rocks from Junagarh State, and subsequently published a paper describing one of them, a monchiquite containing primary analcite, which he found on the margin of a nepheline-syenite.⁶ Recently one or two of his students have re-examined this collection and shown it to be very varied. M. S. Krishnan has made a detailed petrographical study of those collected from the Girnar and Osham hills.⁷ Of these the

⁴ *Rec. Geol. Surv. Ind.*, 1934, **68**, Pt. 3. (in the Press).

⁵ *Mem. Geol. Surv. Ind.*, 1885, **21**, 73.

⁶ *Quart. Journ. Geol. Soc.*, 1901, **57**, 38.

⁷ *Rec. Geol. Surv. Ind.*, 1926, **58**, 380.

or from
interesting
requently
well the
e olivine
rite. In
nk but a
ting the
idate, is
the sills.
artz and
of course
; but the
evidently
long lines
and the
interest.
as found
and Mr.
eral may
at has in
alagoniti-
en traced
deserves
consisting
augite,
with an
ke it has
Provinces.
on of our
a large
asic, some
alkaline,
insula of
ry. These
can Trap
he results
sed about
es. Ever
has been
Kathiawar
ral foci of
d proceed-
ocks. So
s made a
State, and
describing
containing
d on the
Recently
-examined
o be very
a detailed
ected from
these the

majority are nepheline-syenites and dolerites, but other less common types include quartz-porphry, syenite porphyry, syeno-diorite, diorite-gabbro, porphyrite, andesite, olivine-gabbro, lamprophyre, limburgite, obsidian, rhyolite and pitchstone. In this paper six new analyses are given, which the author considers indicate a petrographical province of the 'Atlantic' type. At about the same time K. K. Mathur, V. S. Dubey and N. L. Sharma published a small-scale map of the rocks of Mount Girnar, representing the first attempt to map this focus of eruption. In the accompanying paper intrusions of olivine-gabbro, diorite and monzonite, granophyre, and nepheline-syenite are described.⁸ These are intruded into typical Deccan Trap lavas which they have domed up forming Mount Girnar. Although there is apparently no direct evidence of the mode of origin of these rocks, reasons are given for supposing them to have been derived by differentiation *in situ* through progressive crystallisation, estimates being given to show that the parental magma was of intermediate or dioritic composition. It is thought that crystal settling through gravity has not been operative. More recently, other rocks of Dr. Evans's collection, from the West Gir forest, have been described by S. K. Chatterjee.⁹ These are mostly basic dykes, chiefly olivine-dolerites, but mention is also made of irregular intrusions of acid rocks consisting of spherulitic granophyre, pitchstone, rhyolite and other types. Seven new analyses by the author are given. Other more general papers which include references to the Deccan Trap of Kathiawar, and which are not generally known, are E. Howard Adye's two memoirs on the "Economic Geology of Navanagar State"¹⁰ and on the "Economic Geology of the Porbandar State",¹¹ which are illustrated by a large number of photomicrographs; and a paper by K. P. Sinor on the "Igneous and Sedimentary Rocks of Bhavnagar Territory,"¹² also illustrated.

As regards the more acid types of rock, which have been known to occur in the

Deccan Trap ever since W. T. Blanford published his observations on the geology of the Tapti and Lower Narbada valleys,¹³ K. K. Mathur and P. R. J. Naidu have recently described some acid intrusions and lavas on the coast north of Bombay comprising trachytes, granophyres and rhyolites.¹⁴ These include the "granophyric trachyte" of Kharodivadi described by M. S. Krishnan.¹⁵ Associated with these rocks are glassy gabbros and dolerites. As a result of calculating the silica percentage of the glassy base of these rocks, shown to be about 68%, the authors are led to believe that the acid intrusions represent the same glassy base after it has separated from the partly crystallised magma and solidified away from it. They further conclude that these acid intrusions are a very recent phenomenon. Subsequently, in his presidential address to the geology section of the Indian Science Congress, 1934, Mathur brought together all known occurrences of both acid and very basic rocks of Deccan Trap age, and discussed briefly their origin and age.¹⁶ He suggests that the acid types occur mainly along two lines, one running north and south, from Pavagad hill in the Panch Mahals in the north, to Bombay Island in the south, and one running east and west, along the Narbada valley to as far as Barda hill in Porbandar State in Kathiawar. He further suggests that their origin may be due to the assimilation of acid rocks by the molten basalt, basing his conclusions on certain observations made by W. T. Blanford and P. N. Bose. His view, however, that the rhyolite on Pavagad hill is an intrusion has now been shown to be incorrect, A. M. Heron having confirmed the original view of Dr. Fermor that it is a flow capping the hill and part of the general succession of lavas.¹⁷ As regards the age of these rocks, while recognising the possibility that in certain cases both the acid and the very basic types were extruded at the beginning of the Deccan Trap period, he inclines to the view that for the most part they are very recent in age, attributing their age in some cases to a period subsequent to the establishment of the present

⁸ *Journ. Geol.*, 1926, **34**, 289.

⁹ *Op. cit.*, 1932, **40**, 154.

¹⁰ E. H. Adye, *Memoir on the Economic Geology of Navanagar State*, Bombay, 1914, 262.

¹¹ E. H. Adye, *Reports on the Economic Geology of Navanagar State*, Bombay, 1917, 198.

¹² K. P. Sinor, *Petrographic Descriptions of the Igneous and Sedimentary Rocks of the Bhavnagar Territory*, Bombay, 1927, 72.

¹³ *Mem. Geol. Surv. Ind.*, 1869, **6**, 163.

¹⁴ *Malaviya Commemoration Volume*, 1932, 787.

¹⁵ *Rec. Geol. Surv. Ind.*, 1929, **62**, 371.

¹⁶ *Proc. 21st Ind. Sci. Congr.*, Bombay, in the press.

¹⁷ *Rec. Geol. Surv. Ind.*, 1934, **68**, 17-18.

topography, a conclusion which perhaps some geologists will find it difficult to accept.

It was mentioned above that Dr. Fermor had suggested means whereby the ultra-basic rocks of Deccan Trap age, such as those in Baluchistan, might have been derived from the normal basaltic magma by the sinking of some of the phenocrysts. Further light has been thrown on this problem by W. D. West, who has examined the cores of rock brought up by deep borings put down through Deccan Trap lava flows in different parts of Kathiawar.¹⁸ These rocks include very basic types such as limburgite and ankaramite, interbedded with the more normal Deccan Trap type of basalt. A study of the phenocrysts of olivine, augite and feldspar found in these very basic lavas shows that in each type of rock the composition of the phenocrysts is closely related to the composition of the rock in which they occur. Thus the feldspar phenocrysts in the more basic types are bytownite-anorthite as compared with the medium labradorite

which occurs in the normal Deccan Trap basalt, while the olivines are more magnesian and the pyroxenes more calcic than those found in the normal basalt. These facts are thought by West to show that the different rock types did not originate during the Deccan Trap volcanic period by the sinking of phenocrysts as they crystallised from the basalt, since the phenocrysts differ markedly in composition from those found in the basalt; but that differentiation of the basalt took place long before Cretaceous times, and that the various rock types so formed were already available for extrusion when remelting took place during Upper Cretaceous times.

There is clearly still a large field for research into problems of Deccan Trap volcanic activity, and it is a field which is admirably suited to research by those unattached to official surveys. It must, however, be controlled by detailed and accurate field work, aided by chemical analyses, if it is to be of any real value.

¹⁸ *Rec. Geol. Surv. Ind.*, 1934, **68**, 17.

¹⁹ *Op. cit.*, 1932, **66**, 18.

Chalcolithic Civilisation.

THE explorations carried out between the years 1928-1931 by Mr. N. G. Majumdar of the Archaeological Survey of India have resulted in the discovery of sites on the western banks of the Indus which are reported to be older than Mohenjo-daro in the Indus valley. The people who lived in these areas had not attained any considerable prosperity, for apparently the hilly tracts which they occupied were neither fertile, nor rich in mineral resources. Their dwellings appear to have been constructed out of crude materials such as reeds and wood on a stony basement, and burnt bricks were practically unknown to them. At two places, Ali Murad and Khotras, the remains of the fortified places which have been unearthed, reveal walls built of stones which are in contrast with similar structures composed of bricks in Mohenjo-daro. The hillmen, the lake dwellers and the river inhabitants appear to have known the art

of making pottery on the wheels for domestic purposes. Mr. Majumdar in his report draws attention to the fact that these utensils are capable of being divided broadly into four classes, a classification which he bases on the scheme of colouration, their geometrical shapes, the paintings on their surface and on the degree of polish. Compared with such finds in Mohenjo-daro and Harappa, the Chalcolithic vessels point to an earlier civilisation of great historical importance, of a race of people contemporaneous with the races who dwelt in Baluchistan, Persia and Mesopotamia in the third and fourth millennium B.C. Near the lake Mancher and at the upper levels of Jhukar and Lohumgo-dara, the excavations have brought to light a class of pottery which illustrates the later phases of Mohenjo-daro culture. We await the publication of fuller details of these extremely interesting pre-historic sites.

Observations on Some Plant Abnormalities in Bengal.

By K. Biswas, M.A.,

Royal Botanic Garden, Calcutta.

ABNORMALITIES of various types have been observed in a large number of wild and cultivated species of plants in Bengal. Of such may be mentioned fasciated flowering branch of *Achras Sapota* as shown in Fig. 1. Fasciation of *Tagetes patula*, *Mirabilis jalapa*, *Amaranthus* sp. and *Celosia* sp., and many other species are not of rare occurrence. A branched inflorescence

of *Lagenaria vulgaris*, received

recently, developing from the root stock is an interesting specimen for study.

This abnormal branched inflorescence bears a large number of flowers in aggregation. Investigation is being carried on to trace the factors which led to such a peculiar abnormal basal inflorescence in Cucurbitaceæ. Sections of stems, flowers and fruits do not, however, show anything abnormal. Formation of fasciated structures and other similar monstrosities is often considered to be due to local damage or excess of nourishment at the growing organ either by attack of gall-insects or other agencies. Examples of abnormal flowers of *Hibiscus rosa-sinensis*, *Dianthus* sp. and other horticultural species are many. Flowers borne on the axil of the petals of a single flower and also sterile double flowers due to branching of the thalamus in *Hibiscus rosa-sinensis*¹

are not of rare occurrence. Viviparous seeds of non-mangroove species such as *Zea Mays*, *Mangifera indica*, *Artocarpus integrifolia* are also not uncommon. Double fruits of *Citrus decumana* and double and quadruple fruits of mangoes (*Mangifera indica*)² and brinjal (*Solanum melongena*) sometimes in the form of bifurcating horns are many. A syncarpous fruit of Coconut palm (*Cocos nucifera*) has

been received of late years for an exhibit in the gallery of the Industrial Section of the Indian Museum. Polyembryony in the genus *Eugenia* has been recorded by Tiwary.³

On rare occasions, evidently due to stimulus from local injury at the apices of the stem, crowds of branches develop forming a crown on palm stems. Such a specimen of *Phoenix sylvestris* exists in Southern Calcutta in the courtyards of a residential house. The tree which is still alive is about sixty years old and some of the branches are since dead. The branches come



Branched *Phoenix sylvestris*.

out mainly in two lateral directions and vary from 4 to 5 feet in length, each bearing the usual crown of leaves. Each of these heads in its turn bears also flowers and fruits in proper season, as shown in the photograph I.

¹ Singha, B. N., "Notes on the Terretology of certain Indian Plants," *Jour. Ind. Bot. Soc.*, 1931, 10, 160.

² Tiwary, N. K., "On the Occurrence of Polyembryony in the genus *Eugenia*," *Jour. Ind. Bot. Soc.*, 1927, 5, 124.

¹ Banerjee, S. C., "Terretological branching of the thalamus of a species of *Hibiscus*," *Proc. Sixteenth Ind. Sci. Congress*, 1929, 228.

An interesting specimen of a branched inflorescence of *Musa sapientum* var. *paradisiaca* has recently been observed in a plant growing in the village Gobardanga of 24 Pergunnahs. This plant, as illustrated in the photograph II, has a long inflorescence bearing a large number of spikes which are pedicelled. Thus the inflorescence appears like a branched panicle, each branch bearing a branch of three stalked spikes. The inflorescence carried a total number of about 22 spikes and some of them were bearing green fruits. Syncarpous fruits are also observed which is, as known to the plant terretologists,⁴ due to mutual pressure in the position of the flowers in the inflorescence. A branched inflorescence in *Musa sapientum* was previously reported by Messrs. K. G. Banerjee and G. P. Mozumdar. They made a note in the abstract of papers of the *Proceedings of the Sixteenth Indian Science Congress, 1929*, "on the branching of the main axis and development of 105 perfect and semi-perfect inflorescences in the places of flowers in the axils of spathes on the main axis." Costerus and Smith⁵ in their studies of tropical terretologist, 1915, recorded a branched inflorescence in *Musa paradisiaca*. The same authors have also reported that the branched inflorescence bears flowers and fruits in the following year, if the axis of the inflorescence remains on the plant. *Musa paradisiaca* and other *Musa* species such as *Musa ornata* are susceptible to various types of abnormal growths of the floral structure of the flowers as reported by H. Crüger.⁴ Parthenocarpæ⁴ is also common and has, more or less, been thoroughly studied by various authors together with their anatomical details. Monstrosities such as an inflorescence bursting out from the base of the crown of leaves is not of rare occurrence as once reported by Mr. S. C. Banerjee, Professor of Botany, Presidency College, Calcutta. Abnormalities of the flowers of *Musa superba* and *Musa paradisiaca* were also noted by Agharkar.⁵ It is indeed a matter of some importance to note that such branched inflorescence in *Musa* can bear fruit. The question is the quality of the fruits borne. If by horticultural experiments such branched

inflorescence in *Musa* may be allowed to bear fruits of good quality and of sufficient market value, it means a good headway in the study of horticulture. *Musa paradisiaca* Linn. was formerly considered as a separate species. It was subsequently included by Hooker in *Musa sapientum*



Branched inflorescence of *Musa sapientum*, var. *paradisiaca*.

Linn. which Prain,⁶ agreeing with Hooker⁷ has rightly considered *paradisiaca* Hook., a variety of *Musa sapientum* Linn. *Musa sapientum* Linn. var. *Paradisiaca* Hook. which is widely cultivated in Bengal is commonly known in Bengali as Kanchkala. The systematic position of various types of cultivated bananas is not yet quite fixed although attempts are being made by a large number of systematists and horticulturists in this direction. Wild bananas have also been taken into account.

In 1929, one of the papaya (*Carica Papaya*) plants grown in the compounds of the writer inside the Royal Botanic Garden, Calcutta, exhibited, on one of its leaves, a peculiar superposed leaf-structure

⁴ Penzig, O., *Pflanzen-teretologie*, 1922, 3, 325.

⁵ Agharkar, S. P., "On the abnormalities of the flowers of *Musa superba* and *Musa paradisiaca* sub sp. *sapientum*," *Jour. Ind. Bot. Soc.*, 1931, 4, 18-20.

⁶ Prain, D., *Bengal Plants*, 1903, 2, 1050.

⁷ Hooker, J. D., *Flora of British India*, 1894, 6, 262.

to bear
sufficient
headway
Musa
nsidered
requently
pientum



entum,

Hooker?
a Hook.,
n. *Musa*
a Hook.
al is com-
anchkala.
s types of
uite fixed
by a large
culturists
have also

(*Carica*
ompounds
Botanic
ne of its
-structure

1050.

ia, 1894, 6,

with a stalk developing over the primary leaf-lamina appearing as an extension of the primary leaf-stalk (Fig. 2). Singh, who has recorded a large number of malformations from different provinces of India, mentioned in his note "On the teretology of certain Indian plants" VIII,^a 'stalked funnel or spoon-like structures on the adaxial surface' of the leaf of *Carica Papaya*, 'just above the point of attachment of the petiole and the palmate lamina'. He evidently referred to a superposed leaf. Mozumdar in the *Proceedings of the Indian Science Congress, 1929*, considers similar superposed leaf formation as a case of enation, evidently, as his observation suggests, in want of a more suitable term. He, however, suggests a superficial nature of the growth of this superposed leaf

the Colorado River Valley of Southern California. An otherwise normal leaf bore a secondary leaf-structure erected in double-deck fashion above the primary leaf-blade. The first sight of such a leaf gave a startling sense of novelty, though several plants in California were found to have such leaves, and many others in Southern Florida. A superposed leaf-structure should not be confused with twinning, fasciation, or other lateral modifications of leaf-blades, which have been reported from several families of plants. The *Carica* variation may be described as a vertical addition to the leaf, supported by a secondary petiole growing out of the callus of the primary leaf-blade (see Figs. 6 & 7). A special word seems necessary to characterise the

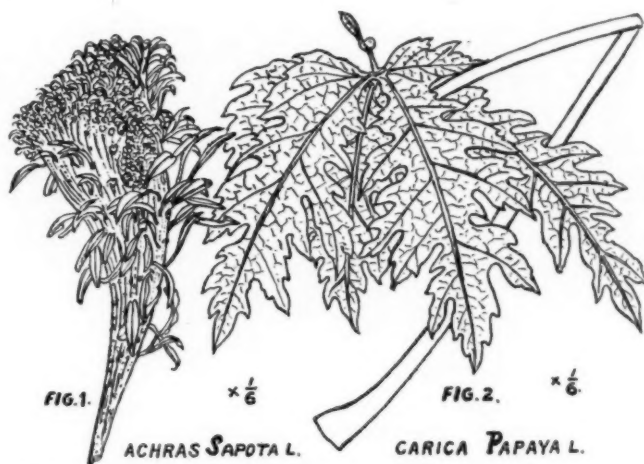


Fig. 1. Fasciated branch of *Achras Sapota* L.

Fig. 2. Superposed Leaf of *Carica Papaya* L.

structure. This interesting variation in leaf structure of *Carica Papaya* has been discussed by Cook^b very lately in his illuminating article entitled "Double-deck Papaya leaves—an example of leaf evolution". Cook rightly suggests a special term *superate* for such an overtopped, double deck leaf, with secondary leaf structure rising above the primary leaf-blade. Cook observes:—"A striking variation was found in 1932 in an experimental planting of papayas in

overtopped, double-deck leaf, with a secondary leaf-structure rising above the primary leaf-blade. Such a word as *superate* may convey the idea of a leaf surmounted by another leaf, as representing the morphological principle of adding new elements of leaf-structure by superposition. Setting one leaf on another may be considered as a method of derivation of compound leaves from simple leaves. The *Carica* variation illustrates a constructive possibility in leaf evolution that apparently has not been recognised in the past, but may be worthy of observation and experimental study."

Palm-shaped and other curiously shaped

^a Singh, T. C. N., *Proc. 18th Ind. Sci. Cong.*, 1931, 270.

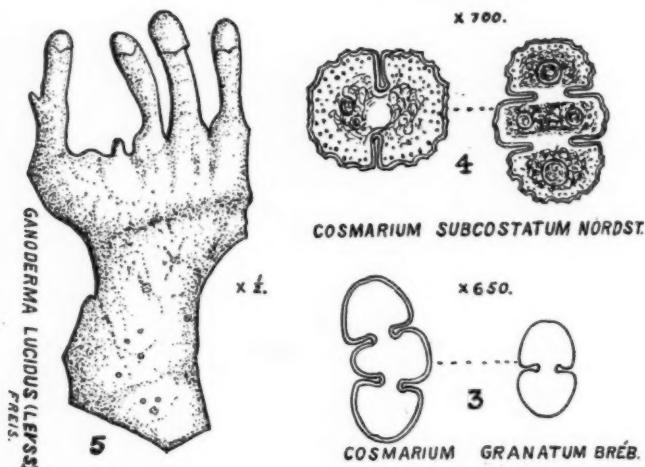
^b Cook, C. F., "Double-deck Papaya leaves, an example of Leaf Evolution," *Jour. of Heredity*, 1934, 25, 226.

fruits of *Carica Papaya* and fruits containing sometimes two or three or as many as seven¹⁰ fruits inside one fruit or one inside the other are of frequent occurrence.

It is suggested by Botanists and Horticulturists that seeds or grafts from the abnormal structure sometimes result in the development of similar abnormal individuals. Such an instance is well established in *Ficus Krishnii*, a horticultural species grown in the Royal Botanic Garden. But reversion to the parent form of *F. Bengalensis*, which may be called a *bud mutation*,¹¹ has actually taken place in one of the branches of this *F. Krishnii* as reported by the author in *Nature*. Details of this will be published in a subsequent note.

Medical College, Calcutta, a specialist in hard Fungi, possesses in his herbarium specimens of *G. lucidus* of various phantastic shapes. Such curious development is very likely due to obstruction in the development of the thallus and need not be taken as anything extraordinary.

Monstrosities or malformations are but freaks of Nature and may be considered as marked aberrant variations appearing suddenly in a plant body. They are by no means less common and to a botanist does not appeal so much. "The relationship between plant deformities and living organisms (ranging from bacteria to insects) was fairly common knowledge in serious horticultural circles before the present



Figs. 3 & 4. Abnormal growth of sister cells of *Cosmarium granatum* and *C. subcostatum*.

Fig. 5. "Hand of a Ghost," abnormal growth of the thallus of *Ganoderma lucidus*.

Abnormalities in Algæ and Fungi are also not very infrequently met with. Conjugatæ among algæ are well known for such variations from normal development. Thus *Cosmarium* species sometimes exhibit peculiar monstrous growth of sister cells (Figs. 3-4). Abnormal conjugation is also reported. A peculiar finger-like form of *Ganoderma lucidus* (Fig. 5) has aptly been designated by the collector as "Hand of a Ghost". Dr. S. R. Bose, Professor of Botany, Carmichael

century dawned. Kerner, in his *Natural History of Plants*, gives a very full account of the matter, while recognition of the cause of fasciation has now become so much an item of popular information as to entitle its mention in Webster's Dictionary." But laymen sometimes ascribe all sorts of explanation to a structure like that of "Hand of a Ghost" and it has been heard that they even go so far as to worship such a structure. Occasionally luminous fungi or bacteria emanating light from a log of rotten wood in a forest during the rains at night create similar surprise among villagers who consider them as a supernatural phenomenon. The actual factors connected with

¹⁰ Mozumdar, G. P., "A Note on some Abnormalities in *Carica Papaya* Linn.," *Proc. Ind. Sci. Cong.*, 1929, 240-241.

¹¹ Biswas, K., "Bud mutation in *Ficus*," *Nature*, 1932, 130, 780.

cialist in
herbarium
phantastic
at is very
velopment
n as any-

are but
sidered as
appearing
re by no
nist does
relationship
d living
o insects)
n serious
present

the production of malformations such as fasciation, etc., have not so far been thoroughly investigated in spite of fair accumulation of literature on this subject. Stoker¹² rightly observes: "A simple gall, such as that appearing on the oak, is due to insect injury to a differentiated tissue. Fasciation, which may be looked upon as a compound bud, or cluster gall, ensues from an invasion of embryonic material. Thus the fasciation of *Asparagus* really extends upwards (with the growing tip), not down-

wards. Excess of nourishment, as Mr. Mulligan surmises, has no connection whatever with the malformation. Mechanical injury, whether accidental (as from the growth coming in contact with an obstruction), or due to voluntary trauma (such as pinching out a growth) cannot cause fasciation, or anything resembling it, unless the wounds become infected." Perhaps detailed physiological, ecological and horticultural investigations may solve the problem in future.

The Rôle of Silicon in Plant Nutrition.

By A. Sreenivasan, M.A.,

Department of Biochemistry, Indian Institute of Science, Bangalore.

EVER since Liebig first propounded his "mineral theory" of plant nutrition (1840), it has been generally recognised that certain elements like phosphorus, potassium, calcium, magnesium and iron are essential to perfect plant growth. During recent years, there has been increasing evidence to show that minute quantities of certain other elements like boron, fluorine, iodine, silicon, aluminium, manganese and zinc are also necessary. The parts played by many of the above-mentioned elements in plant nutrition have been more or less defined: those of others, especially that of silicon, are still comparatively obscure.

That silicon is always present in plants and forms a considerable proportion of their ash constituents is well known (Wicke,¹ Hattensaur,² Wolff,³ Crüger⁴ and others). Though the silicon content of different parts, especially that of leaves, is extremely variable, from the merest traces to over 80 per cent. of the total ash, still complete absence of that element is never observed.

This very general presence of silicon led to the belief that it is an essential nutrient to most plants; that it contributes to the stiffness of the tissues while its absence is the cause for the laying of crops after heavy rains. Later observations showed, however,

that it cannot be placed in the same category as phosphorus or potassium as essential elements of plant nutrition, for a number of investigators (Sachs,⁵ Knop,⁶ Jodin,⁷ Honnel⁸ and others) working with different plants succeeded in demonstrating that silica can be completely dispensed with and that successive generations of crops can be grown to maturity in culture solutions without any supply of silicon beyond that provided by the original seed.

It is hardly likely, however, that a material which constitutes such a large percentage of the mineral constituents can be wholly without any use in the economy of the plant. Experience has indeed taught agriculturists that silica-free plants are at a disadvantage compared with those grown with the normal supply of that element. The latter are able to withstand insect pests and fungus diseases to a greater extent than the former.

Wolff and Kreuzhage⁹ were probably the first to bring to light an entirely new aspect of the rôle of silicon in plant economy. These authors grew oats in culture solutions, with and without silica, and noted that in the former case there was considerable

¹² Stoker, F., "Fasciation," *Gardener's Chronicle*, 1934, **96**, 43-44.

¹ Wicke, W., *Bot. Zeit.*, 1862, **20**, 76.

² Hattensaur, G., *Ber. der Kais. Akad. der Wissenschaft, Wien*, 1890, **99**, **II B**, 29.

³ Wolff, E., *Aschenanalysen*, 1880.

⁴ Crüger, H., *Bot. Zeit.*, 1857, **15**, 281, 297.

⁵ Sachs, J. von., *Flora*, 1862, **52**; *Exper. Physiol.*, 1865, 150.

⁶ Knop, W., *Landw. Versuchs-Stat.*, 1862, **2**, 185; **3**, 176.

⁷ Jodin, V., *Ann. Agron.*, 1883, **9**, 385; *Compt. rend.*, 1884, **97**, 344.

⁸ Honnel, *Heberlands wiss. prakt. Unters.*, 1877, **2**, 160.

⁹ Wolff, E., and Kreuzhage, C., *Landw. Versuchs-Stat.*, 1884, **30**, 161.

increase in the proportion of grains formed, an effect precisely similar to that brought about by addition of phosphoric acid. They concluded that the actions of silica and of phosphoric acid are, in some way, related. This was supported by the field observations at Rothamsted where consistently increased yields were obtained on phosphorus deficient soil by the application of sodium silicate. After due consideration of these results and observations made in the course of special series of water-culture experiments, Hall and Morison¹⁰ concluded that the beneficial effect observed on fertilisation with silicate is due to increased assimilation of phosphoric acid by the plant. They also adduced evidence to show that the related transformations occur in the plant and not in the soil. Gregoire¹¹ grew barley to maturity in nutrient solution and found that on addition of 0.3 per cent. of silicate, there was decided increase in the yield of dry matter. He concluded that the increase was largely due to the absorption of silica by the plants and its consequent utilisation in growth. More than 43.5 per cent. of the ash of the plants receiving silicate consisted of silica while only less than 5 per cent. of silica was present in the ash of the controls. Similarly, Jennings¹² found an increase of 18-20 per cent. in the dry weight of wheat seedlings grown with 1 per cent. silica added to the nutrient solution and also an increase in the silica content of the plants.

Shedd¹³ and Schollenberger¹⁴ both observed that the effect of silicates in increasing growth is particularly marked in the case of soils deficient in phosphates. Lemmermann and Wiessmann¹⁵ observed that even when no phosphate was added significant increase in crop yield could be obtained by application of silicates. They concluded therefore that colloidal silica has a direct effect on plant growth and that it acts in cases of phosphate deficiency by virtue of its ability to partly replace the latter in the plant. The analytical results showed, on the other hand, that the favourable action of silica could be correlated with increased

assimilation of phosphoric acid by the plant (Lemmermann, Wiessmann and Sammett¹⁶). Lemmermann therefore abandoned his earlier views and explained his results by the hypothesis that silica exerts a solvent action on the phosphates present in the soil and renders it more easily available to the plant. His conclusions were criticised by Duchon,¹⁷ while Nanji and Shaw¹⁸ controverted his hypothesis stating that if phosphoric acid be absent, but an abundant supply of silica be available the latter should be able to take the place of phosphate without any detriment to growth; that conditions which are favourable for the assimilation of silica, may even suppress the intake of phosphoric acid, so that the supposition that in the absence of adequate supply of phosphoric acid silica has an indirect stimulating action on the plant is not borne out.

Densch¹⁹ came to the conclusion that silica does not replace phosphoric acid but that soluble silicates induce better growth and greater intake of plant food from the soil. This was corroborated by Gile and Smith²⁰ who also found that silica greatly benefits the growth of plants receiving rock phosphate, presumably by increasing the quantity of phosphoric acid in solution. This benefit was not noticed when the more readily available acid phosphates were used.

Brenchley, Maskell and Warington²¹ showed that under controlled conditions in water cultures, soluble silicate had little effect on the growth of barley if phosphorus was also present, but in the absence of the latter, significant increase in dry weight was induced by the silicate. There was no indication of partial replacement of phosphorus by silicon.

From a statistical analysis of the results on the Rothamsted continuous barley plots, Fisher²² controverted the earlier conclusions of Hall and Morison (*loc. cit.*) and showed that the added silicate increased the total phosphoric acid content of the produce

¹⁰ Hall, A. D., and Morison, G. C. T., *Proc. Roy. Soc.*, 1906, **77B**, 455.

¹¹ Gregoire, A., *Bull. Soc. Chim. Belg.*, 1911, **25**, ii, 85.

¹² Jennings, D. S., *Soil Sci.*, 1919, **7**, 201.

¹³ Shedd, O. M., *ibid.*, 1922, **14**, 233.

¹⁴ Schollenberger, C. J., *ibid.*, 1922, **14**, 347.

¹⁵ Lemmermann, O., and Wiessmann, H., *Z. Pflanz. Düng.*, 1922, (**A**)1, 185.

¹⁶ Lemmermann, O., Wiessmann, H., and Sammett, K., *ibid.*, 1925, (**A**) **4**, 265.

¹⁷ Duchon, Fr., *ibid.*, 1925, (**A**) **4**, 316.

¹⁸ Nanji, D. R., and Shaw, W. S., *J. Soc. Chem. Ind.*, 1925, **44**, 1T.

¹⁹ Densch, A., *Landw. Jahrb.*, 1924, **60**, 142.

²⁰ Gile, P. L., and Smith, J. G., *J. Agric. Res.*, 1925, **31**, 247.

²¹ Brenchley, W. E., Maskell, E. J., and Warington, K., *Ann. App. Biol.*, 1927, **14**, 45.

²² Fisher, R. A., *J. Agric. Sci.*, 1929, **19**, 132.

the plant
Sammatt¹⁶).
oned his
results by
a solvent
in the soil
able to the
ticised by
controvert-
phosphoric
supply
should be
te without
conditions
assimilation
the intake of
supposition
the supply of
an indirect
at is not

sion that
e acid but
ter growth
d from the
r Gile and
ica greatly
eiving rock
easing the
solution.
n the more
were used.
Varington²¹
nditions in
had little
phosphorus
ence of the
weight was
e was no
of phospho-

the results
arley plots,
conclusions
and showed
d the total
the produce

, H., and
316.

J. Soc. Chem.

4, 60, 142.

. Agric. Res.

and Waring

5.

20, 19, 132.

to an extent consistent with the increased yield. Others (Mange,²³ Seki²⁴) have shown that addition of colloidal silica or silicates increases the efficiency of phosphates not only in phosphate deficient soils but also in soil or sand cultures containing useful quantities of that element. Arrhenius²⁵ found no evidence to show that addition of silicate to nutrient solutions in sand cultures reduced the phosphate requirements of plants. Jensen and Lesch²⁶ also obtained benefits from colloidal silica in sand cultures only when phosphorus was added in a difficultly soluble form or in mixed fertilisers which tended to render the phosphate insoluble.

A critical study of the literature would point to the following:—(1) Silicon may not be essential to plant life in the sense that phosphorus is, but it has nevertheless, a beneficial effect on plant growth and leads to increased crop yield. It enables the plant to withstand adverse climatic conditions and resist the attacks of fungi and insect pests. (2) Application of silicate facilitates better intake of phosphorus from either soils which are deficient in that element or mineral phosphates, which are not readily available. When phosphorus is present in a soluble or, at any rate, readily available form the assimilation of the two elements seems to proceed independently of each other. (3) Silicon does not appear to be capable of wholly substituting phosphorus in plant economy but its ability to do so at least partially is still an open question. (4) The seat of interaction between silicon and phosphorus is not well defined but is probably in the soil.

The original theory of Wolff and Kreuzhage (*loc. cit.*), is not tenable since all later work has shown that the extra phosphoric acid derived from the soil is itself sufficient to explain the greater yield without attributing to silica any specific action in economising the phosphoric acid present therein. The view that silica can replace phosphoric acid was held by Gregoire (*loc. cit.*) and first put forward by Lemmermann (who, however, modified it subsequently) and supported by Nanji and Shaw (*loc. cit.*) from

analyses of various cereal straws. This again is hardly tenable, for if the function of the silica is to replace phosphoric acid within the plant, the larger crop due to fertilising with silicates would not contain any greater amount of phosphoric acid, but the general growth of the plant as represented by dry matter produced, or nitrogen assimilated, would be increased. In other words, the ratio of the phosphoric acid to total dry matter and nitrogen would be lowered in proportion to the increased growth. This is not, however, realised in practice as will be seen from the data of Hall and Morison (*loc. cit.*), Brenchley, Maskell and Warrington (*loc. cit.*) and others which show that the ratio of phosphoric acid to nitrogen is generally raised by application of silicate. Again the observations of Densch (*loc. cit.*), Gile and Smith (*loc. cit.*), Arrhenius (*loc. cit.*) and others lead to the conclusion that increased assimilation of silica does not enable the plant to get along with less phosphoric acid and that the beneficial effects of colloidal silica is observed only where phosphorus is present in insoluble or, at any rate, difficultly soluble forms.

That silicon acts as a plant stimulus facilitating better assimilation of phosphorus is the view held by Hall and Morison, who base their conclusion on the observation that the application of silicate lowers the proportion of phosphoric acid in the straw but raises it in the grain. Addition of silica to the ash naturally reduces the percentage of other constituents, while (as mentioned before) the increase in the proportion of phosphate in the dry weight of the crop is alone sufficient to account for the increased yield in grain and straw without postulating the aid of any stimulus to plant growth.

The nature of interaction between silicates and the soil and its bearing on the availability of phosphorus have not yet been adequately studied. The analytical data obtained by Lemmermann, Wiessmann and Sammett (*loc. cit.*) would suggest that the assimilation of phosphoric acid by the plant is increased in presence of soluble silica; that the latter exerts a solvent action on the phosphates present in the soil. Lemmermann's work consisted essentially of experiments in sand cultures and would therefore require repetition under field conditions before any definite conclusions can be drawn. Fisher's analysis (*loc. cit.*) of the results on Hoosfield barley plots, while

²³ Mange, L., *Z. Pflanz. Düng.*, 1928, (B) 8, 305.

²⁴ Seki, S., *C.A.*, 1928, 22, 2803.

²⁵ Arrhenius, O., *Z. Pflanz. Düng.*, 1930, (A) 16, 94, 307.

²⁶ Jensen, W., and Lesch, W., *ibid.*, 1930, (A) 17, 48.

showing that application of silicate increases the availability of phosphorus, still leaves the mechanism of phosphate dissolution unexplained. The experiments of Gile and Smith (*loc. cit.*) with rock phosphate and silica gel are not above criticism. Their pot-culture experiments have not been suitably replicated. Although a study of the solubility of phosphates in presence of silica gel is of much scientific interest, it should be admitted that it cannot reproduce the changes that attend the application of a silicate to the soil. There is indeed considerable evidence to show that the reactions taking place when a silicate is added to the soil may increase or decrease the efficiency of different phosphatic fertilisers and that these reactions vary in different soils. Even when a soluble phosphate is used, a part is fixed by the soil and we are ignorant as to how much of the fixed phosphoric acid is available and how much unavailable. Similar reactions have, in the writer's experience, been found to take place with regard to soluble silicates, so that the extent to which a soluble silicate aids phosphorus resorption is bound to vary with the type of soil under study.

It is possible that a part of the beneficial effect of silicate is due to purely physical causes. In this connection it should be noted that Lemmermann and Wiessmann (*loc. cit.*) obtained beneficial effects only with pure silica gel which is absorptively active, while kaolin, kieselguhr, permutites and other silicious materials gave no increase. Reifenberg²⁷ found that it is possible to peptise finely ground crude phosphate by colloidal silica and to obtain soluble crude phosphate-silica sols. He attributed the increased assimilation of phosphoric acid in presence of colloidal silica to the protective action of the latter which prevents the particles of crude phosphate from secondary aggregation and thus make them more easily available to the action of plant roots.

The practical significance of silicate fertilisation in field practice is still rather ill-defined. Thus, it is not possible to state whether the saving that might result in regard to phosphatic or potassic fertilisers by judicious use of silicates would be an economic proposition. Nicklas, Schropp and Hock²⁸ found that a "silico-super-phosphate"

made by adding kieselguhr at one stage in the manufacture of super-phosphate showed some superiority over the ordinary commercial product. It is possible that some such process might ultimately offer a practical method of exploiting the beneficial effect of silicon in increasing the availability of soil phosphorus.

Nothing is known regarding the possible beneficial effects of silica on soil constituents other than phosphates. Whether the presence of a free supply of soluble silica enables the plant to repair any weak link in the chain of nutrition and get, as need be, more nitrogen, phosphorus or potash from the soil or whether its beneficial effect is solely confined to phosphoric acid is yet to be elucidated.

Although it is recognised that silicon toughens the tissues and makes the plant resistant to adverse climatic conditions, insect pests and fungus diseases, the mechanism of such action is still not properly understood. There is no doubt that this element which forms a high percentage of the mineral constituents of the plant fulfils certain important ecological functions. A fuller understanding of the rôle of silicon in plant growth and metabolism would be of considerable importance in agricultural and horticultural practice.

The transformations of silicon in the swamp soil and their bearing on the nutrition of the rice plant will be of special interest because, of all grain crops, none is so rich in silicon as that plant. The straw and the husk are exceptionally rich and, indeed, as suggested by Nanji and Shaw (*loc. cit.*) the swamp conditions may offer special facilities for the dissolution and intake of silica. No systematic work has, however, so far been carried out on this problem. It is well known that healthy development of the plant, satisfactory yield of paddy and rice of good quality can be obtained only when the swamp conditions are maintained and steady movement of water over the field is ensured: that even those varieties which are generally raised by dry cultivation give comparatively low yields and are of poor quality. The significance of this has so far remained obscure and indeed is rather puzzling when considering that (a) the actual water requirements of the rice plant are not higher than those of most other crops, and (b) its root system is essentially that of a land crop though with some adaptations for aquatic life. The

²⁷ Reifenberg, A., *ibid.*, 1930, (A) 17, 1.

²⁸ Nicklas, H., Schropp, W., and Hock, A., *Arch. Pflanz.*, 1932, 9A, 470.

stage in
e showed
commer-
come such
practical
effect of
ty of soil

e possible
nstituents
the pre-
ea enables
k in the
be, more
from the
is solely
et to be

at silicon
the plant
onditions,
mechan-
rly under-
s element
the mine-
ls certain
A fuller
n in plant
of consi-
and horti-

n in the
the nutri-
of special
s, none is
The straw
rich and,
and Shaw
may offer
tion and
work has,
t on this
t healthy
tory yield
ty can be
conditions
ement of
that even
raised by
vely low
The signi-
d obscure
consider-
uirements
n those of
system is
ough with
ife. The

available evidence would suggest that the swamp soil conditions increase the availability of certain nutrients which are not provided in sufficient quantities under conditions of dry cultivation. Further work is needed, however, to show whether the availability of silicon is increased under conditions of wet cultivation and whether the element thus assimilated

plays any part, direct or indirect, in the nutrition of the rice plant. Researches on these and allied problems are already in progress in the laboratories of the Indian Institute of Science and it is hoped that, before long, it will be possible to throw some light on what has so far remained an enigma in agricultural practice.

Obituary.

Dewan Bahadur K. Rangachari, M.A., L.T. (1868-1934).

THE death of Dewan Bahadur K. Rangachari, M.A., L.T., on May 10, has removed from the Indian scientific world an eminent Botanist, a keen Ethnographer and a venerable personality.

He was born in September 1868 of very humble parentage. Left fatherless at an early age he had to fall on his own resourcefulness and pursued his studies with the help of fees earned by giving private tuition to young school children. He matriculated in 1885, passed his First Examination in Arts in 1888 from the Madras Christian College and took his B.A. degree in 1890 from the Pachappa's College. With the help of a Government scholarship he studied in the Presidency College and took the degree of Master of Arts, taking a first class. He then qualified for the degree of Licentiate in Teaching and in 1895 started his career as Headmaster of the Municipal High School, Anantapur.

In March 1897 he entered Government service as Herbarium Keeper at the Government Museum at Madras. He worked at the Museum for five years until in July 1902 the teaching profession called him again and he was appointed Senior Assistant Professor in Presidency College. In 1904 he acted as Superintendent of Ethnography for a year. His touch with the Museum and Ethnography crystallised into the seven sumptuous volumes on "The Castes and Tribes of South India," which Mr. Edgar Thurston and he published in 1909. Mr. Thurston became a Companion of the Order of the Indian Empire and Mr. Rangachari's work was recognised by the Government of India with the title of Rai Bahadur in 1913.

From October 1909 began his two-fold connection with the Agricultural College and Research Institute, viz., Instructional and Systematic Botany. His appointment as Lecturing Botanist gave him ample

facilities for gathering data and perfecting a series of text-books on Indian Botany suited to various standards. He was one of the pioneers in this attempt at Indianising Botany and of vernacularising the same. His name is predominant in the world of instruction in Indian plant life. He was a Fellow of the Madras University and his wide experience was sought after by other universities and institutions in the organisation of their studies.

Mr. Rangachari was a great Systematic Botanist. As Herbarium Keeper at the Madras Museum, and later as Systematic Botanist in charge of the Coimbatore Herbarium he had a good share in the accrual of the collections enshrined in that Herbarium, which may now claim to be "one of the best in India". The rapid and repeated additions and the continuous consignments from it to Kew, resulted in Gamble's *Flora of the Madras Presidency*, a work which has so far run into 9 volumes. This *Flora* is in part a mute testimony to his colossal but unobtrusive energy. He helped a number of his colleagues, both European and Indian, in a characteristically quiet manner, often doing a considerable amount of selfless work for them. He studied the history of weeds of arable lands and wrote a useful handbook on the same. In addition to systematic work the Herbarium served as a clearing house for much botanical information of scientific and economic interest and many were the enquiries on which Mr. Rangachari threw helpful light.

He was President of the Section of Botany in the 4th Indian Science Congress at Bangalore in 1917 and delivered an address on "The Flora of the Tinnevely Hills". He was one of the Foundation Members of the Indian Botanical Society and was its President for the year 1922.

Mr. Rangachari was a keen photographer

and a sound music critic. In the early days of the phonograph he was enthusiastic in taking successful records of the songs of the aboriginal tribes of the Nilgiris.

In June 1918 he was promoted to the Indian Agricultural Service, one of the earliest to get this recognition. He retired from service in September 1923 and was

decorated Dewan Bahadur. Attuned to very active habits he continued to work with his accustomed vigour until he broke down under the strain into final rest. Simple in habits, warm in his emotions and encyclopedic in his equipment, his was a full and abiding greatness.

G. N. R.

* * *

V. Krishna Murti Iyer, G.M.V.C., I.V.S. (1885-1934).

WE regret to have to record the untimely death of M.R.Ry. V. Krishna Murti Iyer Avergal, G.M.V.C., I.V.S., on the 18th October 1934 at his residence in Parasuwakam. Born in the year 1885 he received the early education in the Kumbakonam College. He joined the Madras Veterinary College in 1906 and graduated from it with distinction in 1909. After a brief service in the Civil Veterinary Department he was appointed lecturer in the Madras Veterinary College in 1910. By dint of hard work and high ability he rose in service till he was promoted to the Indian Veterinary Service in 1922.

He worked in several Indian laboratories and did much important work on nasal granuloma and lymphangitis of cattle. That he should have passed away so early in life is a serious loss not only to his

relations and friends, of whom there are many, but also to the cause of Veterinary Science and Veterinary service. For had he lived longer it is possible that some, if not all, of the results of his investigational experiments would have seen the light of day. Being the fruits of long years of laborious work and study and vast experience they would have been of undoubted value. If he had been spared some time longer it is also possible that with his vast influence with the Government he might have successfully championed the cause of the subordinate service.

The Madras Veterinary College has lost in his death a most energetic, a well-informed and impressive professor who cannot be easily replaced.

S. D. ACHAR.

* * *

Sir Arthur Schuster (1851-1934).

WE regret to record the death of Sir Arthur Schuster, F.R.S., the eminent physicist, on Sunday, October 14, at his home. Born on 12th September 1851, he was appointed Professor of Applied Mathematics in 1881 and was subsequently appointed Langworthy Professor of Physics at Owen's College, Manchester. He took an active part in four eclipse expeditions, the

first one to Siam when he was only twenty-four years of age and the others in Colorado, Egypt and West Indies. After his retirement from the Professorship in 1907, he took a keen interest in the establishment of co-operation in Science and assumed an active part in the International Association of Academies and the International Research Council founded after the Great War.

Letters to the Editor.

Ground-absorption of Wireless Waves and the Electrical Conductivity of the Earth.

ACCORDING to Van der Pol,¹ Sommerfeld's value of "flat-ground" attenuation can be obtained from the formula:

$$\phi(\rho) = \frac{2 + 0.3\rho}{2 + \rho + 0.6\rho^2}$$

where ρ is Sommerfeld's "numerical distance". If d is the actual distance in kilometres from the transmitter ($d \gg \lambda$), σ the electrical conductivity of the ground in e.m.u. and λ the wave-length in km., it can be shown that the numerical distance is given by

$$\rho = \frac{\pi 10^{-15} d}{6\sigma \lambda^2}$$

provided wave-length is not too short ($\lambda > 200$ m.) and the ground conductivity not too poor.

The formula is valid within a few per cent. for values of ρ up to 50.

By applying this formula to the radio-field-strength measurements round the various transmitting stations, we have obtained the following values of the effective conductivity of the earth for some of the metropolitan cities in a few directions:

field strength at any longer distance d . This ratio plotted against distance d in a given direction gives the attenuation curve for that direction. Taking two points on this curve σ is calculated. It is expected that this calculated value of the earth-conductivity over metropolitan areas will be smaller than the actual value of the same, for attenuation of wireless waves in big cities is usually larger than in open countries due to energy-losses in large structures, buildings, etc.

For open countries, the value of land conductivity is of the order of 10^{-13} e.m.u. (see Pol, T. L. Eckersley, Dellinger and Corbeiller⁵).

It is curious that the open-country values of σ obtained from field-strength data are decidedly larger than those obtained by direct experiments with soil which agree on the other hand with the city-values of σ given in the table. For Daventry and Cambridge specimens of soil, for example, Ratcliffe and White's⁶ values of σ under normal moisture conditions are 4.5×10^{-14} and 2.6×10^{-14} e.m.u. respectively ($\lambda = 360$ m.). Our own measurements also by the method of Ratcliffe and White with specimens of

Cities	Directions	Range	σ in e.m.u.	Remarks
Calcutta ($\lambda = 370$ m.)	North-East South	8 - 18 km. 6 - 10 km.	2.60×10^{-14} 6.00×10^{-14}	From Rakshit's field-strength data. ²
London ($\lambda = 360$ m.)	North South	0 - 20 km. 0 - 20 km.	1.80×10^{-14} 1.80×10^{-14}	From Barfield and Munro's data. ³
New York ($\lambda = 492$ m.)	A B C (hilly)	3 - 6 km. 8 - 10 km. 1 - 2 km.	2.90×10^{-14} 8.00×10^{-14} 0.80×10^{-14}	From Bown and Gillett's field-strength data. ⁴
Washington ($\lambda = 469$ m.)	A B	0 - 20 km. 0 - 20 km.	2.80×10^{-14} 1.65×10^{-14}	Ditto.

In computing the above values of σ , we take the attenuation factor equal to $\frac{E_0 d}{E_0 d_0}$ where E_0 is the value of the field-strength at a distance d_0 which is so near the transmitter that there is no perceptible ground absorption and E is the value of

Dacca soil yielded a value equal to 2.2×10^{-14} e.m.u. for $\lambda = 181.5$ m. The percentage of moisture to dry soil by weight is about 20 on the average. "For moderately damp land," Strutt's⁷ value of σ is 5×10^{-14} e.m.u. (frequency = 2×10^6 cycles/sec.). Recent measurements of Smith-Rose⁸ give

¹ Van der Pol, *Exp. Wireless & W.E.*, Oct. 1930.

² H. Rakshit, *Phil. Mag.*, Jan. 1931.

³ Barfield and Munro, *Exp. Wireless & W.E.*, 1928-29.

⁴ Bown and Gillett, *Proc. I.R.E.*, Aug. 1924.

⁵ Pol, Eckersley, Dellinger and Corbeiller, *Proc. I.R.E.*, July 1933.

⁶ Ratcliffe and White, *Phil. Mag.*, Oct. 1930.

⁷ Strutt, *Exp. Wireless & W.E.*, Jan. 1931.

⁸ Smith-Rose, *Proc. Roy. Soc. (A)*, May 1933.

higher values of σ which, however, agree with the average open-country value obtained from field-strength data. For example, $\sigma = 1 \times 10^{-13}$ e.m.u. when the moisture content of the Teddington soil is 20 per cent.

Emphasis should not, however, be laid on these comparisons. There are uncertainties in the soil conditions, viz., nature of the ingredients, moisture-content, vegetation on the surface, etc. Besides, it should be remembered that Sommerfeld's formula is applicable to vertical dipole aeriels. The application of this formula to the field-strength data obtained with a transmitting aerial which gives directional effect cannot therefore be expected to give a correct estimate of σ . Again, the length and the lay-out of the aerial may at times considerably affect the attenuation of wireless waves from which the effective conductivity of the earth is calculated. If the aerial be an inclined multi-pole aerial, a part of the waves may be concentrated upwards. The old transmitting aerial of our wireless laboratory may be mentioned in this connection. The lead-in wire from the horizontal part of the aerial wire was very much inclined to the vertical and the total length from the insulated end of the aerial to the earth-point was about a third of the radiated wave-length. The voltage antinode was at the insulated end and a node somewhere down on the lead-in wire. Electrical oscillations could evidently take place between one part of the aerial to another in a slanting direction causing thereby a concentration of waves upwards. As a consequence, we^o obtained a high value of attenuation in the city of Dacca.

Attention should therefore be directed to the transmitting aerial in order to get a correct estimate of σ by the application of Sommerfeld's theory of ground absorption to radio-field-strength data.

S. R. KHASTGIR.

Wireless Laboratory,
Dacca University,
October 18, 1934.

The Arc Spectrum of Selenium.

IN a recent paper,* the authors have published a set of energy levels newly found out in SeI, in the course of an extensive

^o Chowdhuri and Khastgir, *Ind. Jour. Phys.*, **8**, Part V.

* *Proc. Roy. Soc.*, (A), 1934, **145**, 695.

investigation on the spectrum of Selenium. Some of these levels were arbitrarily designated by the symbols *a*, *b*, etc., *h*. In the light of the (unpublished) results obtained by one of the writers (S.G.K.)† on the arc spectrum of Tellurium, it is possible, by a comparison of these two spectra, to make the following definite assignment of four of the above levels of SeI, thus:

Level Designation		Level Value	
Old	New	SeI	TeI
<i>f</i>	5s(1D) ³ D ₂	13379	14071
<i>g</i>	³ D ₁	13357	13923
<i>h</i>	³ D ₃	13316	13840
<i>e</i>	¹ D ₂	15183	15553

The corresponding levels identified in TeI are also included for comparison in the above table. It will be seen that both in SeI and TeI, the ³D term is partially inverted although in SI‡ it is normal and further the ¹D term is deeper than the ³D, of this configuration.

K. R. Rao.

S. G. KRISHNAMURTY.

Andhra University,
Waltair,
October 28, 1934.

An X-Ray Investigation of the Crystals of M-Azotoluene.

THE crystals of m-azotoluene have been studied by the rotation method and the following values have been found for the dimensions of the unit cell:—

$a = 11.88 \text{ \AA}$, $b = 13.75 \text{ \AA}$, $c = 7.52 \text{ \AA}$.
Thus $a : b : c = 0.8581 : 1 : 0.5469$.

This is in good agreement with the ratio determined by the crystallographers ($a : b : c = 0.8556 : 1 : 0.5438$).§ The crystals belong to the rhombic bipyramidal class.§ The observed halvings show that (hol) planes are

† *Curr. Sci.*, 1933, **2**, 210; see also Bartelt, *Zeits. f. Phys.*, 1934, **88**, 522.

‡ Frerichs, *Zeits. f. Phys.*, 1933, **80**, 156.

§ Gröth, Vol. 5, p. 66.

§ Gröth, *loc. cit.*

Selenium.
ily desig-
In the
obtained
the are
ble, by a
to make
of four of

value

TeI

14071

13923

13840

15553

d in Tel
in the
t both in
partially
rmal and
n the ³D,

AMURTY.

ystals of

ave been
and the
for the

= 7.52 Å.

the ratio
(a : b : c
s belong
S The
lanes are

o Bartelt,

56.

halved when h is odd and (hko) are halved when k is odd, and that the crystals belong to the space group Q_h^{114} . The number of asymmetric molecules required by the space group is eight while that calculated from the above dimensions of the unit cell and the density of the crystals, which was found to be 1.05, is four. This indicates that the molecules possess an element of symmetry which may be a centre of symmetry, or a dyad axis perpendicular to (001) or a plane parallel to (100). Further work on the complete elucidation of the structure is being undertaken.

M. PRASAD.
P. H. DALAL.

Chemical Laboratories,
Royal Institute of Science,
Bombay,
October 1934.

Vitamin C in Indian Food-Stuffs.

WE have lately been engaged in a systematic investigation of the ascorbic acid contents of various Indian food-stuffs, especially fruits, by the technique of Harris and Ray,¹ slightly modified by the introduction of glacial acetic acid to the solution of 2:6-dichlorophenol-indophenol before titration against the trichloroacetic acid extracts of the food-stuffs.² Figures are given below in mg. ascorbic acid per gramme of the fresh edible material. More than 30 food-stuffs have thus been studied, and, of these, the guava, the mango (*langra* variety) and the lichi appear to be the richest sources, containing 1.04, 0.69 and 0.48 mg. ascorbic acid respectively. The different varieties of the mango, *deshi*, *fozli* and *langra*, differ markedly in their ascorbic acid contents, containing 0.22, 0.1 and 0.34 mg. ascorbic acid (see also Guha and Chakravorty³).

The ascorbic acid content of *kancha-mung* (*Phaseolus mungo*) is increased 7.8 times by germination, calculated on the basis of dry weight. Parallel estimations by biological and chemical methods indicate that trichloroacetic acid does not completely extract

the Vitamin C of germinated *mung* (see also Johnson⁴).

The mango (*deshi* variety, obtained from a particular tree) has been found to contain 0.1, 0.05 and 0.2 mg. ascorbic acid at the bud, green and ripe stages respectively. The values for the guava obtained from one tree at the bud and green stages of development are 0.41 and 0.28 respectively. It would seem, therefore, that the process of development of these fruits, unlike that of germination of the seed, involves a progressive reduction in the ascorbic acid content.

B. C. GUHA.
A. R. GHOSH.

Biochemical Laboratory,
Bengal Chemical &
Pharmaceutical Works, Ltd.,
Calcutta,
November 3, 1934.

A Note on the Changes in the Physical and Chemical Characteristics of the Blood Sera of Opium Addicts.

INITIATION into the opium habit is generally found to take place with a view to relieve some mental or physical pains and also certain other ailments such as diarrhoea, etc. In such cases of physical troubles people really find some relief, specially in the beginning, but this gradually develops into a habit which it is difficult to get rid of. The symptoms attending the withdrawal of the habit are extremely painful since it sometimes ends in complete breakdown or even collapse on the part of the addict. Pierce and Plant's observations¹ on the dilution of blood on addiction as well as Barbour, Hunter and Richey's corroborating observations² from a study of the specific gravity of the whole blood serve as clues to some real changes in the blood of the addicts. Henderson and Haggard's³ observation on the increase of carbon dioxide tension is also very interesting from this point of view. The disturbance in the water-balance of the system consequent upon the withdrawal of the habit has been regarded by Rowntree as a condition somewhat allied to water poisoning. From these

¹ Cf. Astbury and Yardley, *Phil. Trans.*, 1924, 224, 221.

² Harris and Ray, *Biochem. J.*, 1933, 27, 303.

³ Guha and Ghosh, *Curr. Sci.*, 1934, 2, 390.

⁴ Guha and Chakravorty, *Ind. J. Med. Res.*, 1933, 20, 1045.

⁴ Johnson, *Biochem. J.*, 1933, 27, 1942.

¹ *J. Pharmacol. and Exp. Therap.*, 1928, 33, 359.

² *Ibid.*, 1929, 36, 251.

³ *J. Biol. Chem.*, 1916, 33, 333.

considerations the present work was undertaken with a view to find out any changes in physico-chemical properties or in the protein fraction of the blood sera of the opium addicts as commonly found in India, since physico-chemical properties and proteins are known to be responsible for many apparent changes of the blood.

From a study of 25 opium addicts the following observations were made. The pH in all the cases is found to be near the lower limit of the normal Indian subjects while the buffer action seems to be considerably lowered. These facts are most probably the necessary outcome of the increased carbon dioxide tension and diminished alkaline reserve as observed by various workers (Henderson and Haggard,⁴ Cobet,⁵ and Barbour, Hunter and Richey⁶). The diminished viscosity and an increased surface tension of the blood sera point to an increase in the fluid content while the slight increase in viscosity of the whole blood which corroborates similar observations of Sollier⁷ may be due to a change in the fluid content of the red cells. As to the protein changes in the blood sera, the albumin fraction which has been found to increase above its normal value is probably responsible for the disturbance in the water balance which was up till now supposed to be due to a variety of causes, like disturbances in fat metabolism, etc. Another important observation is the increase in the euglobulin content of the sera which probably accounts for the nervous symptoms owing to a drainage of lecithin from the nerve cells to form an increased amount of euglobulin as observed in these cases. The pseudoglobulin and the total proteins have been found to decrease below their normal values, the former to a greater extent than the latter. These protein changes appear to be of considerable interest from the point of view of the reshuffling of the lecithin distribution. The field work done in this direction corroborates these observations inasmuch as diets rich in phosphates are found to annul the physical and mental degenerations to a very great extent.

Further work along this direction is in progress specially with respect to the fat metabolism in the system of the addicts,

since fat is known to have important effect upon the water retention in the system and being itself the glyceryl ester of fatty acids is closely related to the glycerophosphates on whose metabolism it exerts an influence. These findings may possibly have some important bearing upon the pathology and treatment of opium habitues.

R. N. CHOPRA.

S. N. MUKHERJI.

Department of Pharmacology,
School of Tropical Medicine,
Calcutta.

October 19, 1934.

Apple Rot caused by *Fusarium moniliforme* Sheldon.

THE writer collected a number of *Fusaria* growing saprophytically. Amongst these *F. viride* (Lechm.) Wr. re-named as *F. solani* var. *medium* Wr. proved to be a new wound parasite of potato tubers.¹ Bacteria-free, single-spore cultures of another species, viz., *F. moniliforme* Sheldon, kindly identified by Dr. Wollenweber, were inoculated into both the "hill" and the "Kashmir" varieties of apples. The "Kashmir" apple differs from the other in being elongated in the vertical or blossom axis, sweeter, less acidic and brighter in colour. Inoculations were made by the method devised by Granger and Horne² and used by Mitter and Tandon,³ with a minor change in the substitution of a straight needle in place of the usual hooked one. The inoculated apples as well as the controls were left undisturbed for 35 days at room temperature (19.5°–22.8°C.). Both the varieties of apples were infected (Fig. 1)



Fig. 1.

and the average damage done was 22.01%. *F. moniliforme* was re-isolated in a pure form from the diseased parts of each apple while the controls remained healthy. As far as the author is able to ascertain there has been no previous record of *F. moniliforme* Sheldon as showing any parasitic activity on apples. *F. camptoceras*, *F. semitectum*, *F. semitectum* var. *majus* and *F. diversisporum*

⁴ Loc. cit.

⁵ Biochem. J., 1923, 2, 137, 67.

⁶ Loc. cit.

⁷ J. d. med. d., Paris, 30, 875.

¹ Mitra, Anil, Nature, 1934, 133, 67.

² Granger and Horne, Ann. Bot., 1924, 38, 212.

³ Mitter and Tandon, Jour. Ind. Bot. Soc., 1929, 8, 212.

effect
m and
acids is
tes on
uence.
some
ry and

failed to infect the apples. It is therefore seen that at least some of the *Fusaria* growing saprophytically in nature are not obligate saprophytes and if they cannot infect healthy fruits and tubers they may still cause a rot by getting into their tissues through accidental wounds.

ANIL MITRA.

Department of Botany
University of Allahabad,
November 1, 1934.

Dichotomous Branching in the Leaves of *Pleopeltis simplex* Sw.

THE normal frond in *Pleopeltis simplex* Sw. is simple, lanceolate, entire. In some specimens of the species collected by Prof. Kashyap in the Jumna Valley* in Tehri Garhwal in July, 1932, fully developed fertile leaves bifurcating once or twice have been found along with the usual simple ones on the same plant. Such fronds are of special interest in throwing some light on the systematic position of the genus. The dichotomous branching is found developed in various stages in these fronds. In some the tip is merely notched, in others there are two small acute lobes, but in several cases there are two well-developed large fertile lobes both of which may again be forked.

The genus *Pleopeltis* formed a part of the comprehensive genus *Polypodium* according to the early writers, Hooker,¹ Christ² and Diels.³ After the separation of *Dipteris* by Seward and Dale⁴ as the sole surviving representative of the family Dipteridaceæ which family flourished in the Mesozoic, Bower⁵ pointed out that many Polypodioid ferns will have to be regarded as derivatives of the Dipteridaceæ. *Phlebodium aureum* was referred to as a probable case. Later on investigations on some species of *Pleopeltis* by Goebel,⁶ disclosed that the genus seemed to show some relationships with the

Dipteridaceæ. The general habit, the area of distribution of this genus which is richly represented in the Malayan region to which *Dipteris* is restricted, the reticulate venation in the lamina forming irregular areoles with free included veinlets, the naked circular or oval sori occurring within the meshes were pointed out as features probably indicating relationship in this direction. The 'diplo-desmic state' of venation which is a characteristic feature of the advanced members (Dipteroids) of a series begun in Dipteridaceæ is also known in one species of *Pleopeltis*, *P. Shraderi*.⁷

A characteristic feature of *Dipteris* is the basic dichotomous venation of the frond. The principal veins divide dichotomously and the secondary ones emerging from them at a wide angle branch and anastomose forming irregular areoles with free included veinlets. In *Dipteris lobbiana* the fronds are repeatedly dichotomously divided ending in long linear lobes with a central midrib and a row of naked circular sori on either side. This represents the simplest state of affairs in the genus. In other species like *D. conjugata* greater complexity is introduced in the webbing of the lamina and the simultaneous multiplicity of the sori which, however, retain their individuality, but the same dichotomous plan is manifest in the venation. In the Mesozoic fossils referred to the Dipteridaceæ the form of the lamina again is characteristically on the same lines. In *Hausmannia dichotoma*^{8,4} discovered by Dr. Marcus Gunn in the upper jurassic rocks on the north-east coast of Scotland and also reported in the beds of approximately the same age at Quedlinberg the leaf is very similar to that of *Dipteris lobbiana*. It is, therefore, evident that the form of the lamina based on the dichotomous divisions of the primary veins is a very consistent feature of the Dipteridaceæ both living and fossil. This fact becomes still more significant when we find that in some of the modern derivatives of the Dipteridaceæ which show on the whole a distinct advance we find the repetition of this ancestral character. The erect leaves of *Platynerium* exhibit this in a remarkable degree. In *Cheiropleuria*, besides the bifurcating leaves simple ones are also commonly found.

* The plants were found growing on the roadside near the wooden bridge on the Jumna about 12 miles below Jumnotri and about 2 miles below the village Rānā.

¹ Hooker, Sir W. J., *Synopsis Filicum*, 1874.

² Christ, H., *Die Farnkrauter Der Erde*, 1897.

³ Diels, In *Engler & Prantl*, 1902.

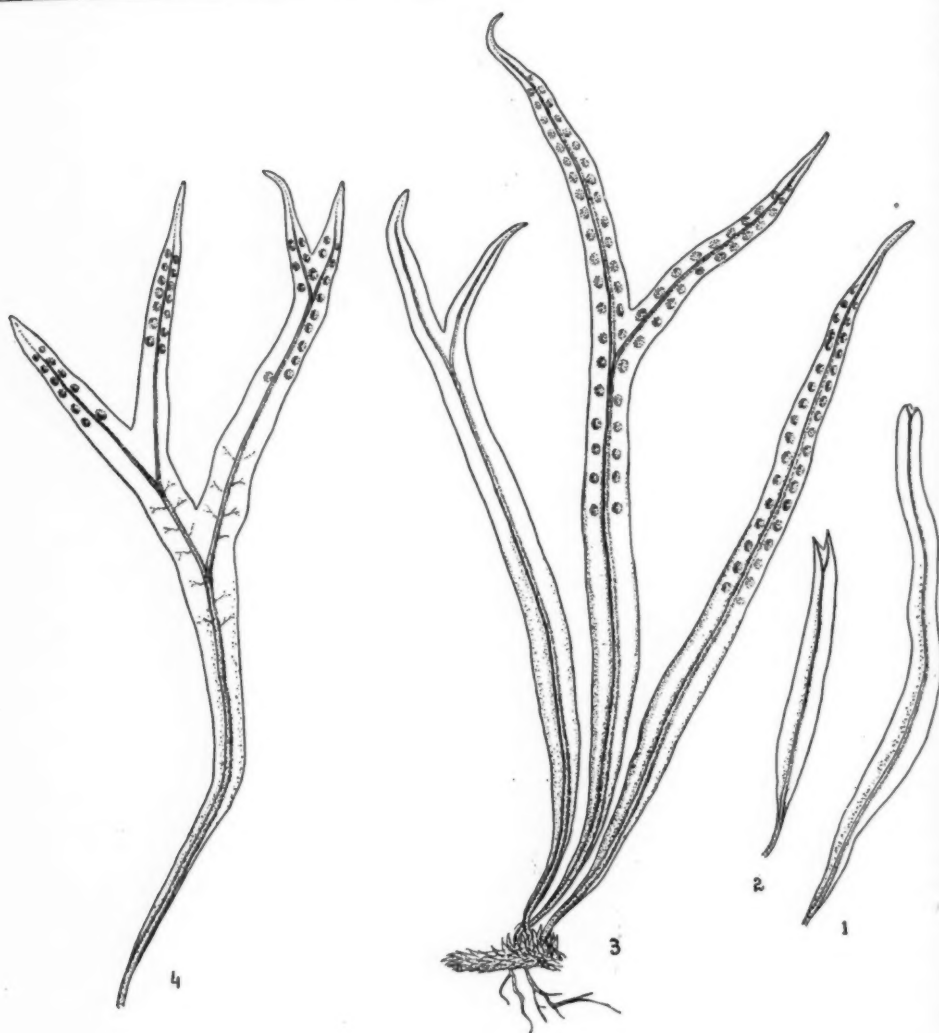
⁴ Seward, A. C. & Dale, E., "On the Structure and Affinities of *Dipteris*, with Notes on the Geological History of the Dipteridine," *Phil. Trans.*, 1901, 194, 487.

⁵ Bower, F. O., *Studies Ann. Bot.*, 1917.

⁶ Goebel, quoted by Bower, F. O., *Filicales*, 1928, 3, 224.

⁷ Do. *Ibid.*, 226.

⁸ Seward, *Fossil Plants*, 1910, 2, 390-392.



Pleopeltis simplex Sw.

1. A frond showing a notch at the apex. 2. A frond showing two teeth at the apex. 3. A plant bearing a normal frond with two others dichotomously branched. 4. A frond showing double dichotomy.

The abnormal leaves of *Pleopeltis simplex* in the light of the above are of special morphological interest. The striking resemblance in form with the leaves of *Dipteris lobbiana*,

⁹ The peltate stalked scales that cover the sori in some species of *Pleopeltis* (*P. macrosphaera*, *P. simplex*, etc.) are of entirely different nature from the indusial coverings. Developmental evidence as well as comparison with other related forms

particularly the young ones and the Mesozoic *Hausmannia dichotoma*, is evident. The ultimate linear lobes in *Pleopeltis simplex* bear a single row of circular⁹ naked sori on reveal their morphological nature as ordinary hairs interspersed among the sporangia that have become flattened at the upper ends resulting in the formation of peltate scales (Goebel, quoted by Bower, *Filicales*, 3, 225).

each side of the midrib as in the above-mentioned species. The primary veins divide dichotomously giving off secondary ones at a wide angle which branch and anastomose forming irregular areoles with blindly ending veinlets as in *Dipteridaceæ* both living and fossil. The occurrence of dichotomous fronds in the present case which probably represents a reversion to the ancestral character is a further support in favour of the genus being placed in the *Dipteroids* as one of the modern representative of *Dipteridaceæ* that have advanced to the level of the *Mixtæ*.

S. R. KASHYAP.
P. N. MEHRA.

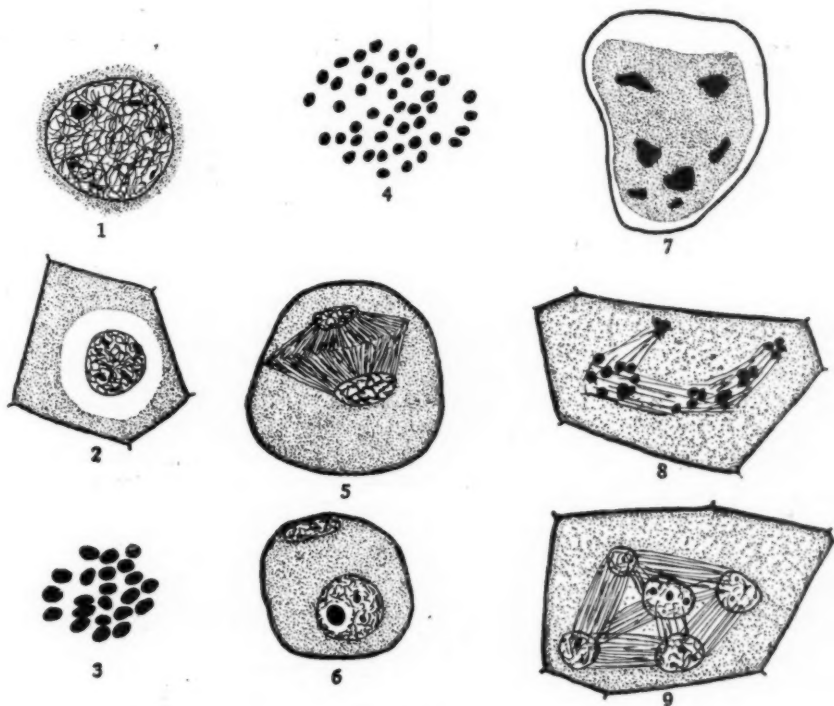
Pollen Sterility in *Zeuxine sulcata* (Lindley).

In *Zeuxine sulcata*, some of the microspore mother cells go through the first meiotic

threads (Fig. 1) and later on the cytoplasm withdraws from the nuclear membrane (Fig. 2).

In the cells that show normal division, 22 bivalent chromosomes can be counted on the heterotypic metaphase plate (Fig. 3). During the very early anaphase when the chromosomes are being just pulled apart, occasionally the univalent chromosomes lie well spread out on the spindle area, so that in favourable preparations 44 univalents can be clearly seen (Fig. 4), each univalent chromosome being almost half in size of a bivalent. So the 22 bivalents seen on the heterotypic metaphase plate can be safely taken as the haploid number for the plant. Moreover, the same number of bivalents have been counted during the heterotypic division of the megaspore mother cell also.

The second meiotic division seems to be



Figs. 1 to 9.

division normally, while others, in the same pollinium, show signs of degeneration even from an early stage. In such cells the nuclei show a dense reticulum of thin chromatin

suppressed; hence "diads" of microspores are formed. The nucleus of the microspore on dividing (Fig. 5) gives rise to a vegetative nucleus and a generative nucleus (Fig. 6)

3. A plant
le dichotomy.

the Meso-
ident. The
tis simplex
ked sori on
ordinary hairs
a that have
s resulting in
bel, quoted by

but these spores are not functional since they decay gradually (Fig. 7).

In some pollinia abnormal spindles (Fig. 8) are formed in the mother cells during the heterotypic division. This results in the formation of non-functional supernumerary nuclei (Fig. 9). Finally the whole tissue of the pollinium is attacked by a fungus and intracellular digestion occurs.

The meiotic irregularities in the microspore mother cells and the final pollen sterility is in correlation with the apomictic development of embryos reported before* in the same plant.

K. N. SESHAGIRIAH.

Department of Botany,
Central College,
Bangalore.

October 22, 1934.

A Peculiar Cotton Plant.

THE number of seeds in the loculi of cotton is a character of some taxonomic importance. Although Watt¹ (1907) is not prepared to attach much importance to this character, Lewton² (quoted by Harland, 1932) considers this as a character of basic importance and has transferred *G. drynarioides*, Seem., to a new genus *Kokia*—because these plants have axillary flowers and the loculi are one-seeded. In view of the importance of the number of seeds per loculus, the following description of a plant which was met with in a field of Mollisoni cotton (*G. Indicum*, var. *Mollisoni*, Gammie) near Chak Jhumera in the Lyallpur district of the Punjab would be very interesting.

Stem, weak, about 3½ feet high, but due to weakness was bending down. Branches long and trailing giving the plant a bushy appearance. Leaves deeply incised and very much reduced in size. Buds were very profuse, corolla colour yellow and a high shedding of bolls. The few bolls which were present were very small in size and invariably 3-locked. Each lock had six or seven ovules, but only one mature seed resting on the base of the lock. When the bolls were matured, only one sound seed

* *Curr. Sci.*, 1932, 1, 102, also Errata Index to Vol. 1, page xiii.

¹ Watt, Sir George, *The Wild and Cultivated Cotton Plants of the World*, 1907, Longmans, Green & Co., London.

² Lewton, F. L., Quoted by Harland, *Bibliographia Genetica*, 1932, 9.

was found in each loculus and the rest of the ovules were very much shrivelled up. The seeds were downy and had very sparse short lint hairs.

Four seeds were collected from this plant. One was found to be faulty, but the other three germinated very well. I have, however, not been able to rear plants and all the seedlings died one after the other. But so far as I could study death was not caused by the operation of genetic lethal factors; but was only a matter of accident.

In all probability the above plant was a mutant and I am putting it on record for the information of other research workers.

MOHAMMAD AFZAL.

Cotton Research Laboratory,
Lyallpur,
October 20, 1934.

On the Trematode Infections in Certain Indian Fishes.

LONG ago, in 1910, Captain Parker obtained some immature stages of a fluke from "Mahaseer", *Barbus tor* (Ham. Buch.) which was first named *Isoparorchis trisimilitubis* and then later on proved to be a synonym of *I. hypselobagri* (Billet, 1898) by Ejsmont. In 1913 Southwell¹ obtained some specimens of this fluke from the gas-bladder of a common siluroid fish, *Wallago attu* (Bl. Schn.). In the same year he also discovered some other Trematodes, such as *Anaporphutum albidum*, *A. largum* Lühe, *A. richiardi* Lopez from some Elasmobranch fishes, viz., *Chiloscyllium indicum* (Gmel.), *Stegostoma tigrinum* (Gmel.) and *Aetobatis narinari* (Euphrasen) respectively. Furthermore, Southwell and Prashad² described some five specimens of flukes (which they simply referred to as Trematode sp.) obtained from certain food-fishes, viz., *Ophiocephalus marulius* (Ham. Buch.), *O. striatus* (Bloch.), *Trichogaster fasciatus* (Bl. Schn.) and *Sacocbranchus fossilis* (Bloch.). In 1921 Bhalerao and Woodland rediscovered some specimens of *I. hypselobagri* (Billet, 1898) from *Wallago attu* from the same region as Southwell did. Chandler³ in 1926, however, recovered some large flukes belonging to the last-named species from the stools of a human patient

¹ Southwell, *Rec. Ind. Mus.*, 1913, No. 9.

² Southwell and Prashad, *Ibid.*, 1918, No. 15.

³ Chandler, *Ind. Jour. A. ed. Res.*, 1926, 14.

in Calcutta, which were identified as such by Bhalerao.⁴ This latter author also obtained some specimens of this fluke from *Ophiocephalus striatus* at Nagpur (C.P.) in 1928, and Faust⁵ also recorded the presence of this parasite in man in China in 1929.

In 1927, Verma⁶ discovered some specimens of *Opisthorchis pedicellata*, sp. nov. from the gall-bladder of two siluroid fishes, *Rita rita* (= *Rita buchanani*, Bleeker) and *Bagarius yarrellii* (Ham. Buch.). Thapar⁷ wrote an account of a Trematode which he named *Gomtia piscicola* obtained from a siluroid fish (name not given). In 1933 several new and interesting species of Trematode parasites of fishes were described independently by Srivastava,⁸ Chatterji⁹ and Harshey.¹⁰ The first of these authors dealt with *Ophiocephalus lobatus*, n. gen., n. sp. and *O. singularis*, n. sp. obtained respectively from the stomach and the intestinal caeca of *Ophiocephalus striatus*, and also *Progonus piscicola*, n. sp. and *P. ovocaudatum*, n. sp. found respectively within the stomach and the intestine of *Ophiocephalus punctatus* (Bloch.), whereas the second author chiefly confined himself with the account of *Astiotrema spinosa*, n. sp., *Ganada clariae*, n. gen., n. sp., and *Masenia collata*, n. gen., n. sp. obtained from the post-stomach and the intestinal regions of *Clarias batrachus* (Linn.). Harshey described some distomes belonging to a new species, *Opegaster anguillii*, n. sp. obtained from the intestine of the common freshwater Indian eel, *Anguilla bengalensis* (Gray and Hardw.).

Lately during the course of our general work on fishes here in Hyderabad we also wrote a note¹¹ on certain helminth parasites obtained from some fishes, and amongst these we recorded the occurrence of *Isoparorchis hypselobagri* (Billet, 1898) in a number of food-fishes, e.g., in four species of *Ophiocephalus*, *Gobius giuris* (Ham. Buch.), *Mastacembelus armatus* (Lacép.) and

Wallago attu; and as a result of our further investigations we now wish to add another fish to the list, viz., the "Feather-back", *Notopterus notopterus* (Pall.) which has fallen a victim to this last-named parasite as well. In all five flukes (*I. hypselobagri*, Billet, 1898) have been obtained from this fish—two from the substance of the liver and three from the mesentery, and on being flattened they measured from 9.5 mm. (l) \times 3.9 mm. (b) to 18 mm. (l) \times 7 mm. (b), where l=length and (b)=breadth.

It must be pointed out that in certain cases the infection is quite or fairly common as with *Ganada clariae* and *Masenia collata*, or less common or even rare in certain other cases, as for example, with *Ophiocephalus* and *Progonus*, or it is quite possible that 50 per cent. of a certain group of fishes may be infected with the parasites, as, for instance, by *Opisthorchis pedicellata*. Since these Trematode parasites have such a wide range of distribution amongst their piscine hosts (most of them being food-fishes, so far as they have been investigated for the present and at the same time being seemingly transferable from one group to the other owing to their predaceous habits) and have also been detected in the human stools, it seems hardly necessary to emphasise that great care should be taken while selecting an edible fish so as to avoid all probable and possible infections (cf. Bhalerao).

In conclusion we take this opportunity of expressing our great indebtedness to the Director as well as to Mr. G. D. Bhalerao, M.Sc., of the Imperial Institute of Veterinary Research, Muktesar (U.P.), for the courtesy of identifying the helminth parasites and for supplying us some most valuable information on certain helminthological subjects which do not constitute our main line of work, but all this is a mere side-track in our investigations, and we venture to publish this note embodying an outline review of the Trematode parasites of certain Indian fishes with the hope of getting some further useful suggestions from others who are actually engaged in this particular direction.

M. RAHIMULLAH.

B. K. DAS.

Department of Zoology,
Osmania University,
Hyderabad (Deccan).
October 1934.

⁴ Bhalerao, *Ind. Jour. Vet. Sci. & Ani. Husband.*, 1932, 2, Part 4.

⁵ Faust, *Human Helminthology*, Philadelphia, 1929, 22.

⁶ Verma, *Rec. Ind. Mus.*, 1927, 2, 29.

⁷ Thapar, *Ann. Parasitol.*, 1930, 7.

⁸ Srivastava, *Bull. Acad. Sci. U.P.*, 1933, 3, No. 1.

⁹ Chatterji, *Bull. Acad. Sci. U.P.*, 1933, 3, No. 1.

¹⁰ Harshey, *Bull. Ac. d. Sci. U.P.*, 1933, 3, No. 2.

¹¹ Das and Rahimullah, *Curr. Sci.*, 1933, 1, No. 9.

Dispersal of Gall Mites by Gall Midges.

WHILE investigating the rôles of the mite *Eriophyes cheriani* Mass.¹ and the new species of gall midge *Microdiplosis pongamiae* Mani² in the peculiar polyp-like galls on the leaflets of *Pongamia glabra* Vent., it was discovered that the midges played a very important part in the dispersal of the mites. Ordinarily these mites are carried by wind and are wafted over long distances from plant to plant in strong gusts. But more often they are also carried by the adult gall midges in their flights.

The midges and the mites develop in the same gall, for which both of them appear to be responsible. The midges pass their larval and pupal periods in the galls. On emerging from the pupæ, the adult midges remain for a short time in the gall itself. At this time the gall cavity is over-crowded by mature mites. Some of the mites escape from the gall cavity but several of them also crawl over the legs, wings and abdomen of the midges and being of minute size, firmly cling to the midges, which do not appear to be greatly inconvenienced on this account. When these midges ultimately escape from the galls and fly away, the mites are also carried along with them and finally when the midges alight on some plant of *Pongamia* to oviposit, some of the mites drop down to the leaf. They then start life on these new plants. I have caught in and around Calcutta several midges on flight, which on examination were found to have these mites on the wings and abdomen and observations have shown that the midges have come from a distance. Galls have thus appeared on some plants in the Indian Museum compound, the mites and the midges having come from some infected plants on the maidan opposite.

This close association of the midges and the mites appears to be of mutual help to both of them. The mites have a sure chance of being safely transferred to new plants of *Pongamia glabra* Vent. (which is their food plant) by the midges. This is clearly an advantage over being blown by the wind and arriving at the food plant by chance. First the mites attack the plant and produce an invagination of the

leaf surface at the place where the eggs of the midges were deposited and thus provide shelter to the developing larvæ of the midges, which also later contribute to the further development of the gall. It is thus remarkable that due to close association, same food and similar habits, the mites and the midges, have become mutually helpful, the latter helping in the dispersal of the former and in turn being provided with a shelter when young.

M. S. MANI.

Entomological Laboratory,
Zoological Survey of India,
Indian Museum,
Calcutta,
October 3, 1934.

Agricultural Education in India.

I HAVE been reading several articles about the necessity for establishing Agricultural Middle Schools for training young farmers. These schools were started but had to be closed for want of boys. In a country where education is meant to procure a job, it is not worth attempting to have special courses without sufficient number of appointments for the candidates that pass out. The schools would have got enough students if those that passed out could find ways and means of getting employed. Thus the same old story of the University man referred to in the said article comes about here also. Therefore the reform should, I fear, commence in the very system of education which should never allow to unmake agriculturists. Give the system of elementary education the required rural bias which many people speak of and never give employment to such as pass out of the elementary schools, so that they may freely go to the village and settle themselves down. The system of education in vogue in the Higher Elementary Schools is meant to be complete in itself and fit the boy passing out of it for rural life. Therefore, on principle it may be wrong to employ him even as a teacher. Therefore all teachers must at least be school finals even in all Elementary Schools of which the Headmasters can be graduates in Agriculture. They can easily give the agricultural colour to the elementary education better than any one else. A garden system of education can be started. If the Champion scheme of concentration is adopted, the Headmaster of one Higher

¹ Massee, A. M., *Ann. Mag. Nat. Hist.*, 1933, 11, 201.

² I have described this new species in my "Studies on Indian Itonididae," shortly to appear in Vol. 36 of the *Records of the Indian Museum*.

eggs of
provide
of the
te to the
is thus
ociation,
ites and
helpful,
l of the
d with a

MANI.

Elementary School can serve several schools in the group. Vernacular tuition in agriculture will not bring them in close contact with the scientific aspect of the subject. They have got, as it is, many items of elementary science subjects to study. All these can be so shaped that they have a rural utility and agricultural bias. An Agricultural graduate will be the fittest person to work it successfully. This reform will mean much superior kind of education to the rural

folk than what they are now getting from the elementary teachers. It must practically reach all the villages in a short time and transform the system of farming in a tangible way within a reasonable period. An Agricultural School started for each district or even taluk cannot but take many years to train a number of people large enough to make the villages in a taluk feel their presence.

"ONE PRACTICAL FELLOW."

Stray Animals.

NEITHER the Provincial Governments nor the Municipalities in India have thought it worth while to take the census of animals kept as pets and others which are not owned. A few years ago the enumeration of such animals in Europe revealed that Germany possessed the least number, and the report did not refer to Scotland. When an enterprising district officer devised an ingenious method of finding out recently the tiger population within his jurisdiction, hopes may be entertained that this shining example will not be lost on the authorities who have to deal with comparatively harmless animals.

The presence of an increasing population of animals prowling about human habitations and becoming intimately mixed up with the daily life of the people, raises a problem of great importance for the municipal authorities to solve. The Municipal Corporation in Bombay which had been carrying on the dog-catching operations recently, is confronted with the problem of keeping the stray dogs well under control. A trained staff, backed by financial resources, finds it difficult to destroy all the dogs, which somehow dodge their aggressors and try to perpetuate themselves as an integral part of the social economy of this prosperous town. The chief complaint against these animals is that during hot weather they become a source of danger, but the possibilities of pet dogs developing rabies are equally great.

Should the municipalities periodically destroy dogs which run about the streets of our towns? In a way their number and the condition of their health give us an idea of the quantity of food thrown out as waste. Do the dogs render any service to the people? They aid the municipalities in their conservancy department. They maintain a strict watch at night. The appearance of people at night, whose faces they are not acquainted with, rouse them frequently and they give a timely warning to the sleeping inhabitants. In times of scarcity, they continue to eke out a living by catching mice and bigger rodents and this is really a great service to man whose stores are raided by these small creatures, besides spreading pestilential diseases. Suppose the dogs in any locality are destroyed and precautions are taken against immigration from the adjoining districts, is there any reasonable assurance that the public health of the particular town would improve? We may diminish the number of dog bites; but in disturbing the balance of the secondary population of our towns, we may perhaps introduce unforeseen troubles. The municipalities have to conduct enquiries into the deeper issues of the complex economies of the towns under their control, before undertaking to eradicate an evil which perhaps may prove after all a blessing in disguise.

Research Notes.

Unternichungen zur Arithmetische theorie der Korper.

OSTROWSKI (*Math. Zeit.*, Band 39, II) has contributed a very interesting and profound work on this part of Modern algebra of which the first part has appeared in this journal and the other two parts are to be published in the succeeding numbers. The work is very extensive and is devoted on the general conception of a prime divisor in abstract fields and their extensions. The definition which he gives of prime divisor P in a field K is that corresponding to every element a , of the field K there exists a number $\omega(a)$ with the following properties. $\omega(ab) = \omega(a) + \omega(b)$ and $\omega(a+b) \geq \text{Minimum}[\omega(a), \omega(b)]$. Then we say that a prime factor P corresponds to each such function $\omega(a)$. This was the definition given by Ostrowski in 1918. On account of the generality of this definition, it was doubted whether this will lead to any constructive results at all, but subsequently Ostrowski proved that in the rational field $\omega(a)$ is actually the highest power of P which divides a except for a multiplicative constant. Introducing another function $\|a\| = e^{-\omega(a)}$, he connects this with Kurschak's idea of an assessing (Bewertung) of the field. The fundamental problem of the theory of ideals becomes the same as that of extending the function $\omega(a)$ to any given extension of the original field K, algebraical or otherwise. Now Kurschak has given a general procedure for obtaining an assessing of any given algebraical extension of a field, starting from a given assessing of the original field. Ostrowski has proved that this is the only method. In this way Kurschak's problem becomes the same as that of finding the prime factors of a prime divisor in an algebraically extended field. So that in this work there is also a simplified proof of Kurschak's theorem for these special extensions. Some difficulties which arise are solved by introducing various notions such as "A relative (with respect to P) perfect field" and so on. The conception of this field also helps us to find out what particular rôle the perfect field of Kurschak plays in the foundation of Ideal Theory. The first part ends with the discussion of the structure of a relative perfect field and their connection with various "Reduction

fields" (Zerlegungs-Korpern). It is also shown that a relatively perfect field is easier to handle than a perfect field, for every algebraic extension of a relative perfect field is once again relatively perfect and that the common elements of two relative perfect fields are once again relatively perfect. The second part of the work is devoted to various divisibility questions such as the orders of prime ideals, etc. The third part gives, among other things, a justification for introducing this general idea of a prime-divisor. Various problems of reducibility of polynomials in perfect and relatively perfect fields are also proved in the first part.

K. V. I.

Remarques sur un probleme de la theorie des nombres.

(S. Wigert, *Arkiv för Matematik, Astronomy och Fysik*, Band 24, I.)

RAMANUJAN was the first to show that the orders of the mean values of $\nu(n)$ which denotes the number of different prime factors of n and $\theta(n)$ which denotes the total number of prime factors of n , are each equal to $\log \log n$. S. S. Pillay (*The Jubilee Volume of the Indian Mathematical Society*) determined further terms in the orders and obtained the best possible orders with and without the Riemannian conjecture. Now Wigert determines the orders of the mean values of $2^{\nu(n)}$ and $2^{\theta(n)}$ starting with the well-known formula

$$\sum_{n=1}^{\infty} \frac{2^{\nu(n)}}{n^s} = \frac{\zeta^2(s)}{\zeta^2(2s)}.$$

He obtains the formula

$$\frac{1}{x} \int_x^{\infty} \left[\sum_{n \leq x} 2^{\theta(n)} \right] dx = \frac{\psi(1)}{12 \log 2} x \log^2 x + Ax \log x + O(x)$$

where $\psi(1)$ and A are certain constants.

Optical Evidence for Molecular Clustering in Fluids.

THE recent issue of the *Proceedings of the Indian Academy of Sciences* (Vol. 1, No. 4) contains a paper by R. S. Krishnan who has given there positive results for molecular clustering in binary liquid mixtures based

It is also
t field is
field, for
a relative
ly perfect
ts of two
gain relat
of the
ivisibility
me ideals,
ong other
tucing this
. Various
nomials in
fields are

K. V. I.

la theorie

Astronomy

show that
 $v(n)$ which
rent prime
enotes the
 n , are each
The Jubilee
cal Society)
orders and
rs with and
ture. Now
f the mean
g with the

$\log^2 x$

$\log x + O(x)$
stants.

Clustering

edings of the
ol. 1, No. 4)
rishnan who
or molecular
xtures based

on a study of the depolarisation of the transversely scattered light. If the incident light is polarised with the electric vector horizontal, the depolarisation ρ_h should be greater than unity for a medium consisting of ellipsoidal particles of finite size and should be infinity for a medium consisting of spherical particles of finite size. R. S. Krishnan has recorded various values of ρ_h at different temperatures for a mixture of dust-free carbon disulphide and methyl alcohol. ρ_h is as much as 4.9 at the critical solution temperature and it diminishes as the temperature is increased but will be greater than unity till about 15° above the critical solution temperature. These results seem to give positive evidence for the formation of large molecular aggregates of size comparable with the wavelength of light even far remote from the critical solution temperature. Mr. R. S. Krishnan has no doubt opened up a new field of research and future experiments in this field may give us an idea of the size of molecular clusters in fluids.

N. S. N.

Nuclear Moment of Caesium.

IN *Zeitschrift für Physik* of October 1934 (Vol. 91, pp. 272-283) Hans Barth has made a detailed study of the intensity ratio of the hyperfine structure components of the caesium line $\lambda=4555 \text{ \AA}$ and has thereby computed the nuclear moment of the caesium atom. The source used is a discharge tube containing freshly distilled caesium in a helium atmosphere at a pressure of 2 mms. excited externally by a high frequency discharge ($10^6 \sim$). The analysis of the line has been carried out by the use of a Hilger echelon of 33 plates and the intensity ratio of the two components of the line 4555 \AA is shown to be 1.41 ± 0.05 by measurements from photographic-photometry. Applying the Fermi formula for this intensity ratio, V, that

$$V = \frac{i+1}{i}$$

where i is the nuclear moment, Hans Barth obtains $i=5/2$ giving for the ratio of the magnetic moments $\frac{\mu_c}{\mu_k}$ a value equal to

1170.

The values obtained in the above paper are in substantial agreement with the results published earlier by Venkatesachar and Sibaiya (*Curr. Sci.*, 1933, 7, 303-306).

The source of the caesium lines employed by them is "a vertical cooled mercury arc lamp with a tungsten anode containing a small quantity of caesium chloride", thereby effecting "a great reduction of normal caesium atoms responsible for the absorption" in the source. The rôle of the mercury vapour in diminishing the width of the caesium lines is also considered. Both the lines 4593 \AA and 4555 \AA ($6^2S_{1/2} - 6^2P_{1/2, 3/2}$) are analysed by Hilger-Lummer plates and the intensity ratio of the components is computed from the density curves obtained from a Cambridge Microphotometer. The intensity ratio is found to be 1.408 ± 0.018 , giving thus a nuclear spin of 5/2 for the caesium atom. Further the Landé $g(I)$ factor of the caesium nucleus has been shown to be 1.11. The following table is intended to indicate the agreement between these values and those of Hans Barth:

	Venkatesachar and Sibaiya	Hans Barth
Lines of Cesium analysed	4593 \AA and 4555 \AA $6^2S_{1/2} - 6^2P_{1/2, 3/2}$	4555 \AA $6^2S_{1/2} - 6^2P_{3/2}$
Intensity Ratio of the components	1.408 ± 0.018	1.41 ± 0.05
Nuclear spin	5/2	5/2
μ_c/μ_k	1180	1170
$g(I)$	1.11	..

Jackson (*Proc. Roy. Soc.*, 1934, 133, 455-464), concludes however that the nuclear spin of the caesium atom is 7/2—a result which is perhaps due to the existence of self-absorption in the source employed. It must be remembered that self-absorption has a tendency to equalise the intensities of the two components (Venkatesachar, *Phil. Mag.*, 1925, 49, 44) with the result that the i value obtained from the Fermi

formula $V = \frac{i+1}{i}$ is always in excess.

L. S.

Refractive Index of an Ionized Medium.

THE electron theory of dispersion taught in the schools looks like a fairly settled question but recently there has been a number of discussions on the question of the conditions under which the Sellmeier or the Lorentz formula is applicable. When it is a question of getting at the optical constants by means of a range of values of the refractive index, the results can be fairly well represented by either kind of formula. But when there are other grounds for assuming particular values for the constants occurring in the two formulae it is found that in some cases the one is right while in others the alternative is correct. Particularly in the case of metals it is found that the Sellmeier formula is appropriate and not the Lorentz formula. This question is studied in detail by C. G. Darwin in a recent paper (*Proc. Roy. Soc., A.* 1934, **146**, pp. 17-46). He shows that the kind of argument usually given in books can be honestly turned about so as to show that in any given case both formulae are correct although they differ in their results. He has used an entirely new type of argument to find out the conditions under which each formula is valid. He finds that in the case of a medium containing free electrons whose charge is supposed to be neutralised by a continuous distribution of positive electricity Sellmeier's formula is the correct one. In the case of a medium made up of neutral atoms the Lorentz formula is required. Considering the question of an electron gas neutralised by a proton gas, the result arrived at is that under certain conditions, which are fulfilled in the ionosphere for example, the Sellmeier formula is correct, while the cases where the argument fails are those in which the Lorentz formula is found to hold. Considering a mixture of two media, one of which obeys Sellmeier's formula and the other follows the Lorentz law, he finds that the Sellmeier function ($\mu^2 - 1$) of the mixture is the sum of the Sellmeier functions of the constituents.

Isotopes of Rare Earth Elements.

THE present-day knowledge of the isotopic constitution of most of the elements is nearly complete, thanks to the work of Aston, Dempster, Bainbridge and others. There was until recently a large lacuna in that the isotopic constitution of the rare

earth elements was very meagrely known. The deficiency has been removed by Aston by his recent work published in *Proc. Roy. Soc., 1934*, **146**, pp. 46-55. The method used by him was a slight improvement upon that described on p. 65 of his "Mass-spectra and Isotopes"; fortunately, pure salts of the rare earths were at his disposal. The results are as follows:—

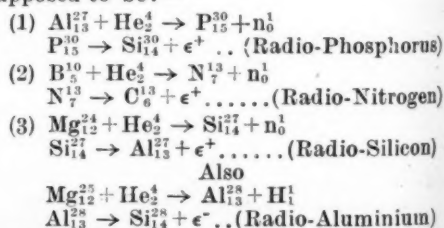
Lanthanum	.. (57):	Simple.
Cerium	.. (58):	140 (88%); 142 (11%).
Praseodymium	(59):	Simple.
Neodymium	.. (60):	142 (36%); 143 (11); 144 (30); 145 (5); 146 (18).
Samarium	.. (62):	144 (3); 147 (17); 148 (14); 149 (15); 150 (5); 152 (26); 154 (20).
Europium	.. (63):	151 (50.6); 153 (49.4).
Gadolinium	.. (64):	155 (21); 156 (23); 157 (17); 158 (23); 160 (16).
Terbium	.. (65):	Simple.
Dysprosium	.. (66):	161 (22); 162 (25); 163 (25); 164 (28).
Holmium	.. (67):	Simple.
Erbium	.. (68):	166 (33); 167 (24); 168 (30); 170 (10).
Thulium	.. (69):	Simple.
Ytterbium	.. (70):	171 (9); 172 (24); 173 (17); 174 (38); 176 (12).
Lutecium	.. (71):	Simple.

Aston remarks that there is an unexplained discrepancy between the value of the atomic weight of Erbium obtained from the mass spectrum analysis (167.24 ± 0.2) and that obtained by chemical methods by Honigschmid (165.204).

Artificial Radio-activity.

(a) α -Ray Bombardment.

Ellis and Henderson (*Proc. Roy. Soc., A.* 1934, **146**, 206) have made a detailed examination of the positron emission from Al, B and Mg, after the elements were bombarded by α -rays from a source of Radium (B+C). The nuclear reactions are supposed to be:—



The number of positrons have been measured by a Geiger-Muller Counter. The

y known.
by Aston
Proc. Roy.
e method
improvement
is "Mass-
sely, pure
s disposal.

(11%).

3 (11); 144;
146 (18).
(17); 148 (14);
5); 152 (26);

(49.4).

(3); 157 (17);
(16).

5); 163 (25);

(4); 168 (30);

(4); 173 (17);
(12).

s an un-
he value of
ained from
24 ± 0.2
l methods

Roy. Soc.,
a detailed
ission from
ents were
source of
actions are

phosphorus)

o-Nitrogen)

io-Silicon)

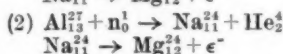
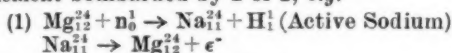
uminium)

have been
unter. The

energy of the α -particles necessary to cross the potential barrier of the nucleus, the periods of the decay of these short-lived radio elements, and the energy of the recoil atoms have been determined. Absorption measurements of positrons from radio-phosphorus go to show the relatively fewer number of slow moving particles in the positron spectrum.

(b) Neutron Bombardment.

Fermi, Amaldi and others (*Proc. Roy. Soc., A.* 1934, **146**, 483) have established that neutrons are more effective bombarding agents than α -particles, protons or deuterons in bringing about artificial Radio-activity in elements. More than forty out of sixty elements investigated have been activated by this method. The active element formed in each case has been identified, though the same is present in extremely minute quantities, by a process of chemical separation after mixing up with its suspected isotope. The active product formed in the case of lighter elements (Mg, Al, Si, P, S, Cr, etc.) has an atomic number less than that of the element bombarded by 1 or 2, e.g.



In the case of heavier elements (Br, Rh, Ag, I, Ir, Au, Ur) the active product is usually a heavier isotope of the element. $\text{Br}_{35}^{79} + n_0^1 \rightarrow \text{Br}_{35}^{80}$ (Active Bromine). Positrons have not been detected in any of the disintegrations. The problem of the capture of a neutron by the nucleus of a heavy atom has been discussed theoretically.

M. P. V. I.

Influence of Charge on the Sedimentation Equilibrium of Colloids.

In presenting a theoretical treatment of sedimentation equilibria, S. Levine (*Proc. Roy. Soc., 1934, 146A*, 597) starts with the idea that owing to the charges on the colloidal particles and the surrounding ions of the electrolyte present forming the so-called "ionic atmosphere" the two particles repel one another when their ionic atmospheres overlap. This results in the attainment of a limiting concentration which is not further affected by gravity. For calculating the magnitude of this effect he uses the Boltzmann distribution introducing an energy term associated with the

charge of the particle and the surrounding ionic atmosphere. The term is evaluated as a power series in concentration of particles by using methods of statistical mechanics. The potential about a particle is evaluated by using the differential equation employed by Debye and Huckel in their theory of strong electrolytes. The results indicate departure from the Perrin's law varying according to charges on the particles and the concentration of the electrolyte present from n (the number of particles per millilitre) $= 1.6 \times 10^{13}$ to $n = 4.0 \times 10^{14}$, with corresponding limiting concentrations lying between $n = 2.1 \times 10^{14}$ and $n = 5.5 \times 10^{15}$.

As the author has pointed out, the influences of factors like hydration and electrostriction have not been considered. This possibly accounts for the fact that the new theory does not reproduce the limiting concentrations observed by Porter and Hedges and by Barkas.

K. S. G. D.

Plant Families in relation to Some Chemical Properties.

In his contribution to the *American Journal of Botany*, 1934, **21**, 427, Mr. Nair has discussed the evolutionary status and climatic distribution of plant families in relation to the physical and chemical properties of the glycerides, volatile oils and alkaloids isolated from them. The analytical data refer to 318 fats, 232 waxes, 938 volatile oils and 299 alkaloids, obtained from 83, 84, 87 and 57 plant families respectively. The families that produce these materials may be divided into six climatic groups, viz., tropical, tropical-sub-tropical, sub-tropical, sub-tropical-temperate, temperate and widely distributed. The data have been statistically examined and it has been shown that there is a consistent variation in some of the physical and chemical properties of the materials according to the climatic distribution of the plants. Thus, the tropical and sub-tropical glycerides possess higher melting points and lower iodine values than the fatty oils of temperate climates. The data concerning refractive indices and specific gravities suggest that the tropical volatile oils have constituents of greater saturation. The average molecular weights of alkaloids are lower and the average melting points higher in the tropical than in the temperate

plants. These data indicate that in general more complex compounds are formed in temperate than in tropical plant families. The physical and chemical properties of the compounds also vary in accordance with the degree of evolution of the plant families containing them and the more highly organised the plants are, the more complex are the chemical products elaborated by them.

B. N. S.

The Development of the Trout Scale.

THE March issue of the *Journal of the University of Bombay* (Vol. 2, part v, pp. 17-32, 4 pls., 1934) contains an interesting article on the development of the Trout Scale by Dr. S. B. Setna, Fisheries Officer with the Government of Bombay. Apart from the excellence of the technique employed and of the histological details worked out, such a study is valuable in fishery work, for "It is well known that the sclerites in some fish formed during the summer are wide apart, while those formed in winter are nearer together. The surface of the scale is thus mapped out into well-marked regions: the summer and the winter bands. In other words, the scale denotes a well-marked rhythm. The facts of development have been utilised for determining the age of the fish." The author has suggested that the formation of the bands is due to the intermittent growth of the scale pocket and to the several tensions and pressures to which the scale is subjected during growth.

In India, the study of fish scales is a desideratum which requires an early attention. Such a study will not only help the development of pisciculture in the country, but will yield data of great biological significance. In the Punjab and the United Provinces, the summer and winter months show extremes of temperature, and the scales would probably be found to exhibit a well-marked rhythm. In Lower Bengal and Madras, on the other hand, the two seasons are not well-marked and in consequence, the sclerites may show a more or less uniform growth throughout the year. As this type of research is of economic importance and especially well suited for the zoology departments of the various universities in India, it is hoped that some interest will be taken in the problem in the near future.

S. L. H.

The Structure and Relationships of Lamellibranchs.

ALASTAIR GRAHAM in an important paper (*Proc. Roy. Soc. Edin.*, 1934, 54, Pt. 2) examines the lamellibranchs belonging to the groups Tellinacea, Solenidae and Solecurtidae and draws certain conclusions regarding the phylogeny of these groups. Of the above, the Tellinacea and the Solecurtidae possess a cruciform muscle while it is absent from the Solenidae. Based on this character and others are his conclusions that the Solecurtidae are more nearly related to the Tellinacea than with the Solenidae.

Cestodes from Lucknow Pigeons.

L. N. JOHRI has described a number of cestodes from pigeons and a few other animals round about Lucknow (*Rec. Ind. Mus.*, 1934, 36, Pt. 2). It has been observed by the author that regarding the infection of the pigeons at least, birds from the slum areas of the town feeding on poor corn were intensely infected, while wild forms from the rural areas showed less or no infection at all. He thinks that the intermediate host is a weevil or some other arthropod feeding on corn. Heavy infection by *Railletina* produced fatal results among the hosts. The author describes a new genus, a few new species and a number of sub-species and varieties. No useful purpose is served by the multiplication of specific names and while a description of outstanding characters meriting the formation of new genera should be welcomed, little differences in dimensions, colour and such other characters and the creation of new species on these characters would only result in the production of a quantity of confusion.

Another paper by B. S. Gogate describing a few new species of Trematodes from the wild ducks of Rangoon appears in the same number of the journal.

"In Vitro" Culture of Pulmonate Molluscs.

J. C. HILL (*Journ. Roy. Micros. Soc.*, 1934, 54, Pt. 3) has summarised our knowledge of the "in vitro" technique with reference to the Pulmonate molluscs. Prof. Gatenby and the author have done much work on this subject and a number of useful aseptic and artificial media have been devised for the growth of cells from

ps of

nt paper
4, Pt. 2)
nging to
and Sole-
conclusions
e groups.
the Sole-
ele while
Based on
onclusions
e nearly
with the

cons.

number of
few other
Rec. Ind.
has been
regarding
east, birds
feeding on
ed, while
showed less
that the
ome other
avy infec-
tial results
describes a
a number
No useful
lication of
ription of
the forma-
welcomed,
colour and
creation of
would only
quantity of

describing
from the
a the same

e Molluscs.

Soc., 1934,
our know-
nique with
molluscs.
have done
number of
edia have
cells from

the gonad of these molluscs. The author was the first to use the Hedon Fleig solution in which medium the cells lived for a long time and developed regular connective tissue networks. Bohuslav's modifications of these methods, though resulting in a prolongation of the life of the cells did not produce any extensive outgrowths.

Minor Chemical Constituents in Some Igneous Rocks.

A VERY interesting article on the minor chemical constituents of igneous rocks has been contributed by G. H. Harcourt in *Journal of Geology*, 42, No. 6. The investigation of rare constituents like Ba, Zr, Mn, Sr and such other elements is determined through spectrographic means. Taking Granites as an example, he has shown that the majority of the minor constituents are common but the variations of their percentages are rather erratic. By studying the occurrence of Silver as a minor constituent in some Granites he has shown that this is characteristic of a particular type of the Granitic magma. On this basis he has suggested a similarity between the Lansdowne

Granites and Granites of Rainy lake. If it is possible to establish different types of rock suites by the determination of minor constituents in igneous rocks, it will not only be a great factor in elucidating petrogenesis, but will also go a long way in locating certain types of ore deposits.

Some Pseudo-Eutectic Ore Textures.

IN a recent article in *Economic Geology*, 29, No. 6, A. L. Anderson discusses the occurrence and development of intergrowths in sulphide ores. By studying such intergrowths in a number of cases such as Galena-Calcite, Galena-Pyrargyrite and Tetrahedrite-Galena he concludes that these textural peculiarities are due to replacements of one mineral by another. In one case he has actually traced the irregular advance of pyrargyrite into galena along convex fronts in addition to tongue-like projections. The replacements are mostly physical in nature and are not accompanied by any changes in volume. Further he has shown that these textures in ores are mainly hypogene replacements, and are comparable to the pseudo-eutectic textures advanced by Lindgren.

Dipole Moments.

DURING the last decade considerable progress has been made towards a precise and quantitative interpretation of the structures of molecules. Among the several methods employed towards this goal Raman spectra and Dipole moments have stood out prominently as they are directly applicable to a study of the more complicated molecules, which have been so extensively studied by chemists and which are not easily amenable to other physical measurements.¹ The interest in the dipole moment of the molecules is particularly enhanced by the apparently simple manner in which it takes account of mainly those parts of a complex molecule which are already known as the seats of chemical reactivity. From the time of the pioneering work of Debye and his colleagues in 1912 and onwards, the interest in the subject has been rapidly increasing, and a large volume of careful experimental work has been turned out mainly during the years following 1924. It was a happy idea therefore for the Faraday Society to devote its Sixtieth General Discussion to the subject of "The Determination and Interpretation of Dipole Moments". The discussion which was held at Oxford from April 12 to 14, 1934, under the Presidentship of Professor N. V. Sidgwick, F.R.S., was attended by almost all the important contributors to the subject and has since been

published as a special number of the journal.² There are in all twenty-four contributions reviewing and discussing every phase of the subject. There is in addition a very valuable classified index of all the moment values determined up to the time, together with the connected details of temperature, method and actual values of polarisation for each substance.

The aspect of the subject which has held the wide interest of the chemists is the original observation of J. J. Thomson³ which was more fully developed later by Eucken and Meyer⁴ that a moment of a definite value could be associated with a bond and with the direction of the bond, so that provided there is no mutual interaction the observed value of the moment of a complex molecule is given by the simple law of vector addition. Later and more careful observations have shown that the above formulation is only approximately valid. C. P. Smyth (p. 752) has reviewed the present position in regard to this and has shown that a bond moment is merely a measure of the electrical unsymmetry of a certain section of a molecule and is affected by the environment of the section. It has not been possible so far to calculate exactly the induction

² Pp. 679-904 + lxxxvi; price 21s.6d.

³ *Phil. Mag.*, 1923, 46, 513.

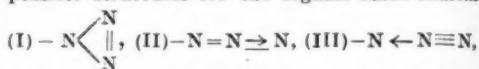
⁴ *Phys. Z.*, 1929, 30, 397.

¹ E. Rabinowitsch, *Naturwiss.*, 1934, 28, 477.

effects of a dipole on the other polarisable parts of the molecule as it is difficult to estimate the actual location of a dipole. Approximate calculations, however, in the case of the halogenated methane derivatives indicate the reality of these effects. There is in addition a possibility of at least a small shift of charges not immediately calculable from induction. Such shifts—electromeric effects—are more conspicuous in aromatic and unsaturated compounds. G. M. Bennett (p. 853) has estimated the additional moment due to this effect in a series of *p*-substituted anisoles, and concludes that when this is taken into consideration the valency angle of oxygen calculated from the moment values are more nearly in agreement with the values estimated by other methods. Some other striking instances where the simple vector law of additivity of moments breaks down are discussed by A. Weissberger, R. Sangewald and G. C. Hampson (p. 884). The three monochloro diphenyls with the chlorine in 2, 3 and 4 positions have different moments, 1.3, 1.8 and 1.5×10^{-18} e.s.u. respectively, although diphenyl itself has moment zero, and chlorobenzene has moment 1.5. Similarly, α and β chloronaphthalenes have different values of moment. As the moments of the corresponding dichloro diphenyls are complicated by the possibility of rotation around the diphenyl link, a series of ten disubstituted chloronaphthalenes have been synthesised and their moments studied. The results indicate that there is a particular shift of electrons in the molecules toward the substituents, and this shift contributes a moment of the order of 0.2 in a direction perpendicular to the bridge bond. However, when substituents are introduced in the same positions in both rings the polarisation in question does not occur. It has also been shown elsewhere⁵ that an influence of this order exists in quinoline and isoquinoline. O. Hassel (p. 874) has discussed the information that can be gathered regarding the stereochemistry of cyclohexane from a study of the dipole moments of the halogen derivatives of the same. Most of the results go to show that at ordinary temperatures in the solution state the high-symmetric *trans* form of the ring is by far predominant and stable. In a discussion of this paper, J. D. Bernal points out that a transformation from the *trans* to *cis* form should involve not only considerable activation energy but also a definite transition energy. J. E. W. Le Fevre, on the other hand, shows that the moment of 1:4 cyclohexadione indicates that this derivative definitely exists in the two strainless forms foretold by the older stereochemistry.

Pauling and his collaborators have recently shown that a large number of molecules exist with the same nuclear structure but in different valency states, i.e., with different electronic structures. All these component structures exist simultaneously in a resonance equilibrium, the actual ground state possessing an energy equal to or less than that for any of the individual structures, the difference, called the resonance energy, giving a measure of the stability of the molecule compared to that of any of the parent states. This resonance affects other properties of the molecule as well; thus the inter-nuclear distances and the valency angles

assume intermediate values which are usually disproportionately near to those in the stiffer structures. In his report L. E. Sutton (p. 789) has gone into this question in considerable detail from the dipole moment point of view and finds that in several instances, e.g., isocyanates, N_2O , etc., the observed moment can be best accounted for by taking into consideration the several possible structures in resonance. In another extremely lucid paper N. V. Sidgwick (p. 801) has analysed all the evidences in favour of the three possible structures for the organic azide radical



and comes to the conclusion that the azide radical is a mixture of the two open chain forms II and III in resonance. This phenomenon of resonance is then discussed at length by several members present, beginning with the President's very apt remarks about possible limitations to the various permissible resonating formula for one and the same nuclear structure. It may be added here that recent studies of the moments of picolines and quinolines (M. A. Govinda Rau and B. N. Narayanaswamy, *loc. cit.*) also support the existence of resonance in these molecules.

There are on the other hand a large number of molecules in which the nuclear structure itself is not rigid, such as those in which free rotation is possible about a single bond. The moment of such molecules is generally dependent on the temperature in as much as the extent of deformation of the molecule is governed by the intra-molecular potentials and the degree of thermal agitation. In many cases where rotations are possible the moment is still independent of temperature indicating that the molecules are locked up in definite oriented positions, sometimes due to the existence of quantum resonance. C. T. Zahn (p. 804) has reviewed his own considerable contributions to this subject, while J. E. Lennard-Jones and H. H. M. Pike (p. 830) have pointed out some interesting complexities in the mechanics of this free rotation, such as in the case of dichloro ethane where the principal axis of rotation passes through the two chlorine atoms for the *trans* model and gradually shifts on to a position between the Cl—Cl and C—C lines for the *cis* state. Another mathematical investigation by W. G. Penney and G. B. B. M. Sutherland (p. 898) in which the quantum mechanical method of electron pairs is applied to the structure of H_2O_2 and N_2H_4 , leads to the conclusion that these molecules are not symmetrical but have unsymmetric skew structures, and the moment values calculated for such structures are in good agreement with the observed values. An extremely interesting paper in this connection is that of G. C. Hampson (p. 877) who finds that the symmetrical linear arrangement ascribed to the dicovalent compounds of mercury, such as the mercury halides, is not supported by the observed finite moments for the *para* disubstituted derivatives of mercury diphenyl. It is suggested that there is a considerable degree of flexibility in these molecules, the Hg—C link having a certain angle of swing. In the accompanying discussion de Laszlo has confirmed this suggestion of Hampson and estimates the actual angle to be about 30° from his electron diffraction

⁵ M. A. Govinda Rau and B. N. Narayanaswamy, *Z. Physik. Ch. (B)*, 1934, **26**, 23-44,

are usually
the stiffer
on (p. 789)
able detail
and finds
ates, N_2O ,
accounted
the several
p. 801) has
the three
ide radical

$\leftarrow N \equiv N$,

ide radical
s II and III
esonance is
members
s very apt
the various
ne and the
added here
of picolines
and B. N.
support the
es.

arge number
cture itself
ee rotation
the moment
pendent on
the extent of
ed by the
degree of
re rotations
pendent of
olecules are
s, sometimes
ance. C. T.
considerable
E. Lennard-
ve pointed
the mechanics
the case of
al axis of
orine atoms
shifts on to
-C lines for
investigation
Sutherland
ical method
structure of
clusion that
l but have
the moment
are in good
values. An
connection
o finds that
nt ascribed
mercury, such
ported by
disubstitut-
nyl. It is
the degree of
link having
companying
is suggestion
al angle to
diffraction

experiments with the vapour of dibrom diphenyl mercury.

The rest of the contributions to this symposium deal with the more physical aspects of the subject, such as the influence of the solvent on the calculated value of the moment (F. H. Muller, p. 729). It is now recognised that the moment obtained decreases with the increasing dielectric constant of the solvent, but there is no general agreement regarding the exact law by which this decrease takes place. A logical formula that can eliminate this solvent influence and thereby allow of an exact evaluation of the moment for the free molecule, will be a considerable advance on the present-day technique of determining the moments of molecules. The potentialities of the Raman-Krishnan theory in this direction are emphasised by F. R. Goss and E. G. Cox, in the discussion that follows, and P. Debye has pointed out that since solvent influence is measured by the dielectric constant, the solvent molecules near the dipole molecule are not the only ones involved. A direct consequence of this reducing influence of dielectric constant on the calculated polarisation is to vitiate the Debye law of linearity of polarisation with $1/T$ when determined by the infinitely dilute solution method. The resulting decrease in the slope of the $P-1/T$ line and therefore of moment and the fictitious high values for the atomic polarisation are illustrated in a separate communication by H. O. Jenkins (p. 739) with his experimental results on the polarisation of nitrobenzene in dekaline at 25° and 142° . The reported values of atomic polarisation are further discussed by S. Sugden (p. 734) who finds that no clear relationship can be traced between moment and P_A nor can finite P_A values be allotted to groups. In contrast to the well-investigated cases where the calculated polarisation decreases from the gaseous measurements to those in solutions, F. Fairbrother (p. 862) has observed a considerable increase in the polarisation of the hydrogen halides when dissolved in benzene and in CCl_4 . The suggested explanation is that owing to the smallness of the molecules, the induced dipoles in the surrounding solvent molecules will be large and their effect will tend to increase the electron density at the halogen end of the molecule, or in other words, transform the covalent link to an ionic binding. In the keen discussion that follows there is no agreed opinion regarding the suggested explanation. The nature of the bond, whether ionic or atomic, the binding energies and the internuclear distance, and their bearing on the dipole moment are discussed in a separate communication by W. H. Rodebush (p. 778).

The rôle of inter-dipole forces on the polarisation and other physical properties are discussed in a series of three papers. The interaction energy between two dipoles at a distance r apart is proportional to $\frac{\mu^2}{r^3} \propto n\mu^2$, where μ is the moment and n the number of dipoles per unit volume. Van Arkel and J. L. Snoek (p. 707) have showed that the simplest empirical equation in which this energy term can be successfully introduced is

$$\frac{\epsilon-1}{\epsilon+2} = \frac{4\pi n}{3} \left(a + \frac{\mu^2}{3KT + cn\mu^2} \right)$$
 where c is a constant independent of solvent, concentration or moment, so long as there is no

intermolecular association. Indeed this equation can be used to furnish a sharp criterion for the existence of association from the abnormal values obtained for ϵ and the influence of solvent, etc., on the same. In another communication A. R. Martin (p. 759) seeks to estimate the nature of the interdipolar forces from the curvature in the partial vapour-pressure-composition curve of solutions of dipoles. This same interdipolar energy between the dipole molecules in a pure liquid contributes an additional term to the cohesion energy due to purely London forces. Van Arkel (p. 698) has shown that the rise in the boiling point of the liquid due to this additional

term is given by $T_D = 1.53 \times 10^3 \times \frac{P_0 \mu^2}{R^3 V_n}$, where

T_D is the Debye contribution to the boiling point, P_0 the optical polarisation, R the mean radius of the molecule, and V_n the molecular volume at the boiling point. In larger molecules, the distance between constituent dipoles when appreciable must also be taken into consideration and this helps to predict the order of succession of boiling points in a group of isomers.

Another physical characteristic of a dipole molecule is the finite time it takes to orient itself in the direction of the applied field. This is the theme of P. Debye (p. 679) for his opening contribution to the whole symposium. When the period of oscillation of the applied field is of the same order as the time of relaxation of the molecule, a difference in phase is set up between the field and the polarisation with accompanying energy absorption and decrease in dielectric constant. Of these the energy absorption is a first order effect, and measurements of high frequency losses particularly in dilute solutions—for which alone the equations are valid—should give absolute values of the relaxation time τ according to the formula

$$W = \left(\frac{\epsilon + 2}{3} \right)^2 \frac{\omega^2 \tau}{2V} \cdot \frac{N\mu^2}{3KT} f E^2,$$

where W is the energy produced in ergs per c.c. and per second, ϵ the dielectric constant of the non-polar solvent, E the amplitude of the applied field, f the mol. fraction and V the molal volume of the solvent. J. Malsch and G. Martin have developed the necessary technique for these measurements. The results show that different values of τ for one and the same molecule in different solvents are far from proportional to their viscosities as will be expected from Stokes' formula. τ is probably an individual characteristic constant depending upon the particular form of the molecule. P. Girard (p. 763) has studied the dielectric constant and dispersion of a number of alcohols and finds evidence for the existence of association complexes. In polyhydric alcohols the association complexes are polar in character with different dispersion regions, and break down with rise in temperature. On the other hand, tertiary alcohols are typical examples where non-polar association complexes are formed. J. W. Williams (p. 723) has described briefly some experiments to verify quantitatively Debye's theory of dispersion, and to apply the equations to calculate the molecular weight of proteins from the relaxation times. In certain cases good agreement with experimental values of molecular weight have been obtained, but in others discrepancies have appeared. The sources of error and

attempts to solve them are discussed. Debye's formula seems also to be applicable, at least roughly, to solutions in polar solvents such as alcohol and water.

The free orientations of dipole molecules are even more hindered when they are located as in a crystal lattice, on account of the strong internal potential fields. Still the existence of a pronounced dispersion as in ice points to a probability for spontaneous passage of a molecule from one direction to another. J. Errara and H. Sack (p. 687) find a similar dispersion also in the crystals of magnesium and yttrium platinocyanides and attribute this to the existence of one or two very loosely bound water molecules per platinum atom. It is also observed that the orientation of the field with respect to the axes has a pronounced effect.

When an ionic lattice is placed in an electric

field there is an additional polarisation due to the relative displacement of ions. This additional polarisation increases with rise in temperature while the usual volume polarisation decreases. E. Bretscher (p. 685) has calculated the resulting temperature coefficient of dielectric constant on the basis of the existing theories of interionic potential for the case of NaCl and CaF_2 crystals, and finds a discrepancy between calculated and experimental values, which is attributed to certain imperfections in the theory.

The symposium is thus seen to cover almost the whole field of the dielectric properties of matter, and when taken along with the exhaustive table of moments given as an appendix, this volume of the *Faraday Society Journal* is easily the most up-to-date guide to the subject of Dipole Moments.

M. A. GOVINDA RAU.

Industrial Possibilities of Some Research Work done in India. *

ALTHOUGH, prior to the time of the Great War, efforts at industrial developments in India were not wanting, yet, the phenomenal enthusiasm for the starting of new industries and the serious attempts to explore and exploit industrial possibilities in the country witnessed during the period 1916-18, can be directly traced to the stimulus given to industrial research by the Great War. Since then, the interest has been, more or less, kept up and energetic steps are now being taken by the Central Government to investigate market conditions and centralise research work in industries.

Original work carried out in recent years holding out industrial possibilities, can be reviewed under 5 heads:—(a) Researches resulting in permanent factories, (b) Researches resulting in factory operations still in the initial stage, (c) Researches resulting in factories operating on a commercial scale, but which for various reasons, have been discontinued, (d) Researches which have been of proved commercial interest, but which have not been fully exploited, and (e) Researches that await commercial consideration.

The researches pertaining to the distillation of sandalwood oil, the utilisation of local oils for soap manufacture and the manufacture of turpentine may be mentioned as examples which come under the first group. Under the second category, comes the manufacture of ceramic wares and gas mantles. Acetone with increased demand under the exigencies of War, may be cited as an instance of a temporary industrial venture. Other industries which may be mentioned in this connection are the manufacture of glue and gelatine, thymol and strawboards. The manufacture of glue deserves careful consideration; a material of a somewhat inferior quality can be produced as a cottage industry and may therefore prove of particular interest to India.

Researches of proved commercial importance but which have not been fully exploited, deserve special consideration. They concern improvements in large-scale industries already existing in

India. The lac industry is a case in point. It is now faced with competitive synthetic substitutes on all sides, but possesses certain virtues which give the natural resinous product a distinctive character; the latter, therefore, cannot be easily substituted. This is particularly true in the manufacture of electrical insulators, where the decomposition products of lac which may be formed when exposed to high electrical pressures, are still non-conducting, which is not the case with similarly formed products from artificial substitutes. By imposing a strict scientific control during the various stages of the industry—production, manufacture, storage and transport, and exploiting the by-products of the factory, it should be possible to set the whole industry in order and the natural lac will undoubtedly hold its own against competition.

Another industry which offers considerable scope for improvement, is the fibre industry. In the year 1931, of the $3\frac{1}{2}$ million tons of coir produced for spinning, only $1/10$ million tons were used, and here is ample room for enterprising inventive genius to utilise the waste. The short fibres which can be recovered from the cotton seed appears to be quite suited for paper manufacture, and the pre-treatment of this and other cellulosic materials for paper manufacture demand careful and systematic enquiry. Fermentation or "retting" may be found cheaper than chemical treatment. Other varieties of fibres that are available in India are the *sun* hemp, linseed straw, megasse, rice straw and bamboo.

The problems of the oil industry in its many ramifications are so numerous that there is ample room for continued activity. The proposed Technological Laboratory at Nagpur to be subsidised by the Lakshminarayan bequest intends to take up the subject, and it is hoped that fresh lines of enquiry may be opened up.

The question of power alcohol has been in the minds of Indian technologists for many years, but although the country abounds in exceptionally cheap raw materials, such as mahua, cassava and artichokes whose utility as raw materials have been tested, the production of alcohol has not proceeded much beyond the laboratory trials. Papaya has been shown to

* Abstract of a course of two lectures delivered by Dr. Gilbert J. Fowler, D.Sc., F.I.C., under the auspices of the Society of Biological Chemists, India, on the 22nd and 26th October 1934.

due to the additional temperature decreases, the resulting constant on of interionic Fe_2 crystals, calculated and attributed to

almost the positive table is volume of the most up Moments. DA RAU.

point. It is substituted virtues which a distinctive not be easily true in the where the which may be cal pressures, not the case from artificial scientific control try—produc-transport, and factory, it the industry in utedly hold

considerable re industry. re tons of coir million tons m for enter- the waste. covered from te suited for tment of this paper manu-atic enquiry. ound cheaper varieties of are the ann e straw and

in its many hat there is The proposed gpur to be an request it is hoped pened up. has been in ts for many bounds in ach as mahua, ility as raw production of beyond the en shown to

contain more fermentable sugar per acre than any other crop in India, and holds out vast possibilities for industrial exploitation.

Another source of natural wealth which requires only energy and persistence to be utilised with great benefit to the food supply of the mass of the population, is human and animal wastes including activated sludge which can be employed as a starter for composting town and farm refuse thus yielding a valuable fertiliser.

Other industries whose progress can be ensured by systematic laboratory investigations are the dyeing industry, wood distillation, chromium products, refining of crude saltpetre, preparation of papain and manufacture of vinegar.

A large proportion of the literature that has accumulated, concerns those problems, which await commercial consideration. To mention only a few, a good deal of work has been carried out on cereals and cereal products, and in the fruit and vegetable industry including its by-products, such as, papain, pectin, tartaric and citric acids, beverages and condiments. With the exception of rose water and sandal oil, little effort has been made to develop the possibilities of perfumes from Indian flowers and scented grasses. The economic

handling of the enormous quantities of molasses from sugar factories, and its utilisation, presents numerous problems awaiting solution.

The argument that, provided raw materials could be exported with profit, it would be unnecessary to spend money in setting up factories to utilise the raw materials and convert them into useful commodities, is illusory since it disregards the importance of the circulation of wealth. There is a considerable field in India, to-day, for small industries requiring comparatively little capital, and no opportunity should be lost to exploit them. The large-scale industries require not only considerable capital, but also courage and vision. A country which has produced Jamsetjee Tata may hope for other captains of industry.

"Ultimately all wealth must come from land since men cannot live without food. In India, it cannot be doubted that every effort should be directed towards a more intensive agriculture. Improved agriculture should render possible a higher standard of life in the countless villages of India, and with this higher standard a greatly increased demand for the products of mechanical industry."

B. N. S.

Science Notes.

Acetyl Group in Lignin.—Mr. Pulin Behari Sarkar of the Dacca University writes: "The fact that wood and other lignified materials when distilled with dilute mineral acids afford acetic acid, has caused several investigators to assume that lignin contains acetyl groups. This is still an unsettled fact, as no lignin preparation until now has been found to give acetic acid under similar conditions. According to Jonas (*Papier Fabrikant*, 1928, 26, 221) the acetyl group is split off from lignin by very strong HCl during isolation even in the cold. He includes therefore an acetyl group in his modification of Schrauth's formula. Heuser (*Paper Trade Jour.*, 1930, 83, 75) also considers the acetyl group as characteristic of lignin.

"Raw jute but not lignin, even when separated with 42% HCl under the mildest conditions, gave acetic acid on distillation with dilute H_2SO_4 , or on being first boiled with KOH and then steam distilled after acidification with H_2SO_4 . Acetic acid was estimated in raw jute and jute delignified with ClO_2 without any previous boiling with 1% alkali. It has been found that raw jute gave 6.26% acetic acid while delignified jute gave 7.54%. As jute contains 15.43% of lignin, 100 g. of raw jute means 84.57 g. of delignified jute. Again, since 100 g. of delignified jute gave 7.54 g. of acetic acid, 84.57 g. of it would give 6.37 g. of the acid. Actually, raw jute gave 6.25% acetic acid, which fact therefore proves in an indirect way the absence of acetyl group in lignin."

Absence of Aldehyde-group in Lignin.—Mr. Pulin Behari Sarkar of the Dacca University writes: "In a former communication (*Curr. Sci.*, 1934, 2, 406) it has been pointed out by the author that the reducing action of lignin is due to the two OH groups attached to the benzene ring in the ortho-position. Further proof has now been obtained for this from the results of methylation.

Lignin isolated by 42% HCl at room temperature has been separated into two fractions by dilute NaOH. The soluble portion which reduces Fehling's solution very readily, has been methylated with dimethyl sulphate and 45% KOH at a temperature below 25° (Urban, *Cellulose Chemie.*, 1926, 7, 73). After a single treatment the reducing property diminished considerably and after the second, it disappeared altogether. The colour changed from deep black to light brown and the product no longer dissolved in alkali. As only the OH groups are attacked by dimethyl sulphate in presence of alkali, the absence of reducing property in methylated lignin therefore proves conclusively that lignin contains no aldehyde-group.

It may be mentioned here that the loose combination of dimethyl sulphate with the CHO group as in the case of sugars, breaks up easily on warming with dilute acids or alkalis."

Harvesting Sugarcane.—Mr. Y. K. Raghunatha Rao, Chemist, Mandya Sugar Factory, writes: "To know when a sugarcane crop is ripe for harvesting it has been the practice to cut down several stalks, send them to the factory for pressing out in a handmill and analyse the juice. Lately the method is the inexpensive and simple one of noting the 'Brix' or density of the juice from the cane in the field with a hand refractometer, the point of sampling being about the middle of the stalk. The pith is bored out from an internode of the cane with a 'Gempol' knife and pressed to give a drop or two of the juice, whose Brix is noted. A variant of the method is to collect the juice drops from all the stalks in four selected stools and observe the brix of the mixed sample.¹

¹ *I. S. J.*, 1933, pp. 37, 274, 359; 1934, pp. 235, 240, 320.

A slightly different procedure was followed in testing the sugarcane fields at Mandya. The pith of the cane was not bored out. The juice was taken out of the cane directly by a grooved knife (Zeiss) or by means of a pair of tongs with sides broadened so as not to injure the cane and fitted on the inside with a piercing button and grooved so as to let out the juice.² Errors due to evaporation and insufficient cleaning out of the former juice sample should be guarded against; in this respect the knife is simpler. Every fifth internode from the visible air roots was sampled.

No. of canes examined 48. Variety H.M. 320.

12 months old.

TABLE I. (Brix)

Internode	5th	10th	15th	20th (top.)
Stool I.	21.1	20.7	20.1	17.3
" II.	21.3	21.6	22.6	20.7
" III.	20.8	21.7	21.5	20.1
Calculated Total	21.1	21.26	21.26	18.2
Observed Total	21.2	21.30	20.60	—

TABLE II. (Brix)

Internode	5th	10th	15th	20th (top.)
Stool IV.	21.5	22.4	20.0	17.1
" V.	22.7	22.7	22.6	21.0
" VI.	22.2	22.9	22.8	21.9
Calculated Total	22.2	22.7	22.0	21.0
Observed Total	—	—	22.2	—

From the results it is found that a collective sample from the middle of the stalks is a fair average. However, such a sample does not distinguish between ripe and nearly ripe cane. The convergence of the brixes of the top, middle and bottom parts is a better criterion. In unripe canes the brix at the middle is more than at the bottom and much more than at the top. The values are nearly equal at ripeness, the limit of divergence being $\pm 1^\circ$ Brix.

The ripeness test should therefore consist in collecting separately average samples from the top, middle and bottom of all the canes in four or five selected stools, proper weight being given to damaged or borer attacked canes and noting the brixes of the three average samples. When the three values are nearly equal the cane is ripe. This method involves no greater expense or labour and is a very reliable one.¹¹

Asiatic Society of Bengal.—Among the interesting exhibits that were shown and commented upon at the recent meeting of the Society held on the 5th November, were six China plates, representing the three famous Buddhist pilgrims. These were exhibited by Mr. Johan van Manen. "Genuine Chinese porcelain is as famous as its fakes are feared. India has in the course of its history absorbed a substantial amount of valuable specimens of Chinese ceramics, which come to light from time to time, and after the great European War, Calcutta has become an important dispersion centre for old China, both genuine and spurious. The plates exhibited represent the three famous Buddhist Pilgrims, Fa Hsien, Hsuan Tsang, and I Tsing. The period mark gives the date of manufacture as that of Hsuan Ho, the one but last Emperor of the first Sung Dynasty, i.e.,

A.D. 1119. This is almost unbelievable, though some Chinese friends who have been consulted think the plates probably genuine."

A New Technique of Micro-Analysis.—Dr. Charles Rosenblum of the University of Minnesota has evolved a new technique of micro-analysis for determining extremely minute quantities of chemical elements. Many of the heavier elements have radio-active isotopes which are chemically indistinguishable from them, but which make their presence known by their disintegration and are detectable by physical methods. The proposed method consists in adding to the solution of the element, a small amount of radio-active element with which it is isotopic. The mixture is chemically inseparable, yet the amount of radio-active disintegration detectable is a measure of the concentration of the inert element. "If now a fraction of the element is removed from the solution by precipitation or electro-deposition, the same portion of the radio element is simultaneously removed; the radio element thus acts as an indicator of the inactive element."

Enzymic defence against Cancer.—The possibility of treating cancer by artificially stimulating the enzyme activity of an organ in order to aid the natural defensive mechanism of the body has been foreshadowed by the work of Dr. E. F. Schroeder and Dr. Ellie MacDonald of the Cancer Research Laboratories of the University of Pennsylvania. Arginase occurs in large quantities in the tumourous tissue and is closely associated with rapid growth processes; at the same time the arginase normally present in the liver decreases as the tumour grows. The concentrations of two other enzymes in the tumour—cathepsin and phosphatase—on the other hand, diminish as the cancerous growth becomes more necrotic. Phosphatase, in particular, is found in high concentrations in the kidneys of rats resistant to cancer. "The implanted cancer tissue might liberate into the blood stream certain enzyme activators or stimuli, which would cause other organs to respond by setting up a defensive mechanism in the form of increased enzyme activity. If the stimulus is sufficient the animal may throw off the cancer; if not the cancer grows. This opens an interesting field in the possibility of artificially stimulating enzyme activity of an organ as a defence against further growth of the cancer."

Air Conditioning.—Dr. Moscicki, one of the most eminent chemists in Poland and President of the Republic, has invented a device whereby the air of sick rooms may be conditioned so as to simulate that of a mountain resort. He has succeeded in reaching his objective of greater purity, a higher percentage of ultraviolet rays, a greater degree of ionisation, and a lower atmospheric pressure together with the introduction of small amounts of ozone (*Ind. Eng. Chem., News Edition*, 1934, 12, 317).

A New Colour Exhibit in the American Museum.—According to a report in the *Natural History* (1934, 34, 589) an interesting colour exhibit of special interest to naturalists has been arranged in the Hall of Reptiles of the American Museum. The exhibit includes living specimens showing

² *Sugar News*, 1934, p. 306.

able, though
been consulted

—Dr. Charles
Minnesota has
analysis for
quantities of
vier elements
re chemically
which make
tegration and
The proposed
lution of the
tive element
are is chemi-
of radio-active
asure of the
"If now a
ed from the
ro-deposition,
is simultane-
ous acts as an

The possibility
stimulating
in order to
ism of the
ay the work
MacDonald
of the Uni-
occurs in large
and is closely
esses; at the
esent in the
rs. The con-
the tumour-
other hand,
becomes more
r, is found in
of rats resis-
cancer tissue
eam certain
would cause
p a defensive
ased enzyme
t the animal
t the cancer
field in the
ing enzyme
ainst further

one of the
and President
vice whereby
ned so as to
ort. He has
ve of greater
violet rays,
lower atmos-
roduction of
Chem., News

an Museum.—
ural History
ur exhibit of
een arranged
an Museum.
ens showing

three types of colour mutations, a bright yellow variety of the common pond frog, a black melanistic form of the garter snake, and a red variation of the chicken snake. By way of comparison a normal specimen of each species is also included.

The green colour of the normal pond frog is due to a reflection phenomenon. The rays reflected by certain guanine-containing cells backed by black pigments, pass through a filter of oil-containing cells thus imparting a green appearance to the skin. The yellow "sport" lacks the black pigment cells and the consequence is that the short light waves are not reflected back through the yellow filter, the skin therefore appears yellow, not green. Mutations or germinal changes are the first stages in the formation of new species and the various colour "Sports" are of special interest to the naturalist.

Bombay Government Fishery Scheme.—In our issue for November 1933 ("Science News", p. 184) attention was directed to the steps taken by the Government of Bombay, in pursuance of the recommendations made in Mr. H. T. Sorley's Report, to improve the supply of fish to the city of Bombay by introducing a system of transporting fish from the fishing grounds to the city by motor launches. It will be learnt with considerable satisfaction that the scheme has proved useful and that within one year the Government has already launched a third motor vessel in connection with the scheme. It is also learnt that enquiries are being made by the local fishermen regarding the feasibility and cost of converting ordinary fishing crafts into power boats. It may, therefore, be presumed that the local fishermen are beginning to realise the benefit to their trade by the adoption of rapid and modern forms of transport. The progress of the small beginning made by Bombay in improving its fish trade should be watched with keen interest by other parts of India, especially Bengal and Madras, where primitive transport methods are still employed, in spite of an increasing demand for fish and a consequent rise in prices.

It is not yet fully realised that Fishery Industry is next only to Agriculture in this country. To relieve the distressing poverty of the masses and to improve their diet, it is absolutely essential to develop the fishery resources of India along scientific lines at an early date as was pointed by us in the October issue of 1933.

Report of the Zoological Survey of India.—A copy of the report of the working of the Zoological Survey of India for the years 1929-32 has been received by us. The Survey which is associated with the Indian Museum is the premier Zoological institution in India and has a library which is one of the largest in the East. The report sets forth the scientific activities of the Survey both in the field and in the laboratory, the papers that were published by the staff in the journals of the Museum and gives a general idea of the working of the Institution. A number of original contributions were made by the staff and research workers of the Survey and were published in the Records and the Memoirs of the Indian Museum and other journals. The recent retrenchment effected in the contribution of the Government to the Survey has crippled its resources considerably and has resulted in

seriously hampering the good work that the Survey has been doing.

Report of the Building Research Board for the year 1933, H. M. Stationery Office.—The report comprises a general review of the activities of the Building Research Board during the year 1933 and a detailed account by the Director of Building Research of the progress of numerous investigations that are being carried out at the Building Research Station. Architects, Builders and Surveyors are finding the Annual Reports of the Building Research Board a valuable means of keeping abreast with progress in building research. An important section of the report deals with problems of practical interest submitted to the Station during the year.

The appointment of Mr. J. C. Fernandes as Agricultural Technician to the Government of Mozambique, Portuguese East Africa, is announced. He was a student of the Poona Agricultural College, and was Principal of the Government Agricultural School, Sanguem, Goa.

Mr. R. K. Bhide, Economic Botanist to H. E. H. the Nizam's Government, retired in March 1934 after 6 years of service. He entered the service of the Nizam after retiring as Crop Botanist to the Government of Bombay. His mature experience helped him to organize crop improvement work in Hyderabad along modern lines. He worked primarily on rice and castor. Strains of rice evolved by him are popular and are spreading in the State. In the 1934 Science Congress at Bombay he participated in the Symposium on Plant Genetics contributing a paper on 'Recent Advances in Breeding Castor'. He was a trained artist and a veteran plant-breeder, who retires at 61 years of age to a well-earned rest.

Sixth International Congress for Scientific Management.—The meetings of the Sixth International Congress for Scientific Management, which will take place in London from July 15th to July 20th, 1935, will be held at the Central Hall, Westminster, and in the Halls of the Institution of Civil Engineers and of the Institution of Mechanical Engineers.

It is the purpose of the Congress as a whole to obtain papers and discussion of practical applications of scientific management in all its phases. References to actual technique will relate to specific problems and how they have been met.

Another aim of the organisers of the Congress is to provide opportunities for members to meet, in an informal way, people from other countries interested in the same problems as themselves, and this will be a marked feature of the organization. The Congress will appeal to all those holding managerial positions in any phase of our national life, but it is a further object of the Congress to arouse a more public interest in the subject of management.

Previous Conferences have been held in Amsterdam (1932), Paris (1929), Rome (1927), Brussels (1925) and Prague (1924), but never before in Britain. More than two thousand members were enrolled for the Paris Congress, and it is expected that at the Conference in London next year this number will be exceeded.

Full particulars in regard to the arrangements for the Congress may be obtained from the Secretary, Sixth International Congress of Scientific Management, 21, Tothill Street, London, S. W. 1 (*The Journal of the Royal Society of Arts*, 1934, 82, No. 4265).

Fourth Silvicultural Conference.—In the week October 28th to November 3rd a meeting of Forest Officers from all parts of India was held to discuss Silvicultural matters, particularly from the point of view of research. Over thirty delegates were nominated representing all provinces as well as Indian States with extensive forest interests. The last conference was held in 1929 when Kashmir was the only State represented, but this time Travancore, Mysore, Hyderabad (Deccan) and Chamba Tehri also sent delegates. The Agenda were mainly based on those of the last conference, progress made in giving effect to the resolutions then passed being reported and further developments discussed. Important among the items are methods of research in tropical evergreen forests, the significance of local races of species extensively planted such as teak, forest grazing, and the preservation in perpetuity of selected forest areas. Special attention was also given to soil problems and ecological investigations in their bearing on forestry.

Presentation of Papers before Scientific Meetings.—We are quoting below the suggestions made by the Group of Divisional Officers of the American Chemical Society (*Cf., Ind. Eng. Chem., News Edn.*, 1934, 12, 300) for the effective presentation of papers by authors before scientific meetings convened for the purpose of reporting and discussing research work. Repeated criticisms levelled against the method of preparation of papers are generally valid and it is hoped that by observing the suggestions, the authors would materially assist in improving the scientific value of the meetings.

1. **Arrangement of Material.**—Manuscripts as prepared for publication are seldom suitable for oral presentation. The paper should convey clearly to the hearer: (a) the purpose of the work, (b) the experimental method, (c) the results obtained, and (d) conclusions. The nature of the material and the time available for presentation will determine the degree of emphasis to be placed on each sub-division. The author should make certain by trial against his watch that the essential points can be adequately presented in the time allotted to the paper.

2. **Statement of Purpose.**—Orient the audience clearly as to the nature and purpose of the work. A lengthy historical review is generally out of place.

3. **Technique.**—Describe the experimental method employed so as to indicate the principles involved. Omit details of apparatus or procedure unless there is some particularly novel development. Such data may be included in the published paper but will bore your audience.

4. **Statement of Results.**—Present the results graphically, preferably with diagrams. Lantern slides are more clearly seen than hand-drawn charts. These slides should be of standard size (3.25 x 4 inches) and should project clearly on the screen. Regardless of who has made the charts

or slides, try them from the point of view of the audience before presenting them at the meeting. Do not read tables, a procedure which wastes time and destroys interest but point out the general trend of the data.

5. **Conclusions.**—Summarise the evidence and discuss the importance of the results or conclusions to the particular field of research involved.

6. **Manner of Presentation.**—Do not read from a manuscript verbatim. Talk directly to your audience in a clear, loud voice. Do not face black-board or screen while speaking. Articulate distinctly.

The Microid Physical Series.—Messrs. Griffin & Tatlock, Ltd., with a reputation of over one century as makers of scientific instruments, have recently put on the market a whole range of physical apparatus incorporating several improvements in technique. They are admirably adapted for the demonstration of physical principles, and have aroused keen and wide-spread interest among those who have seen and tested them.

The second edition of their catalogue No. 115 x, illustrates a selection of apparatus suited for demonstrating physical principles which should prove invaluable to progressive educational institutions. Each apparatus is illustrated and described separately and experimental notes are provided. Those interested may address enquiries to their Indian Agents, B5, Clive Buildings, P. O. Box No. 2136, Calcutta.

New Carl Zeiss Quartz Spectrograph.—As a result of many years' experiments Messrs. Zeiss have now put on the market their all-metal Quartz Spectrograph "(Qu) 24". The instrument is of extremely attractive design and completely enclosed. The spectrum can be photographed over the whole range from 2000 Å to 5800 Å, special importance having been attached to good definition of the lines in the region between 2000 Å and the short wave end of the visible spectrum. The total length of spectrum is about 230 mm. on the 24 x 6 cm. plate. In order to enable scientists in India to examine this spectrograph Messrs. Adair Dutt & Co., Ltd., will, as they inform us, exhibit the instrument during the next Science Congress Exhibition in Calcutta. We do not doubt that a large number of our readers will be interested in this product of a world-renowned firm.

We acknowledge with thanks the receipt of the following:—

"Actualités Scientifiques et Industrielles," Nos. 134, 137, 142, 161.

"Journal of Agriculture and Livestock in India," Vol. IV, Pt. V.

"Journal of the Annamalai University," Vol. III, No. 2, October 1934.

"The Biochemical Journal," Vol. 28, No. 4.

"American Journal of Botany," Vol. 21, No. 8.

"Journal of the Indian Botanical Society," Vol. 13, No. 2.

"Canadian Journal of Research," Vol. II, Nos. 2 & 3.

"Chemical Age," Vol. 31, Nos. 795-798.

"Berichte der Deutschen Chemischen Gesellschaft," Vol. 67, No. 10.

ew of the
e meeting.
ch wastes
t out the

vidence and
or conclu-
involved.
read from
y to your
face black-
Articulate

re. Griffin
over one
ents, have
e range of
al improve-
admirably
physical
wide-spread
and tested

No. 115 x,
suited for
ich should
educational
trated and
notes are
es enquiries
ings, P. O.

aph.—As a
essrs. Zeiss
r all-metal
instrument
completely
otographed
to 5800 Å,
ed to good
ween 2000 Å
e spectrum.
230 mm. on
e scientists
ph Messrs.
inform us,
ext Science
We do not
ders will be
d-renowned

ceipt of the

industrielles,"

ivestock in

University,"

3, No. 4.

. 21, No. 8.

l Society,"

" Vol. II,

—798.

hen Gesells-

"Experimental Station Record," Vol. 69, Index Number.
"Educational India," Vol. I, No. 4.
"Indian Forester," Vol. LX, No. 11.
"Forschungen und Fortschritte," Jahrgang, 10, Nos. 28—29.
"Indian Forest Records," Vol. 20, No. 11 (Back Numbers Vol. 17, Pts. 1, 9 & 10; Vol. 18, Pts. 1—8, 13).
"Report on Coconut Enquiry in India," by Dr. J. S. Patel. Imperial Council of Agricultural Research. (Govt. of India Publication.)
"Medico-Surgical Suggestions," Vol. 3, No. 10.
"Nature," Vol. 134, Nos. 3386—3389.
"Natural History," October 1934.
"Journal of Nutrition," Vol. 8, No. 3.
"Journal of Chemical Physics," Vol. 2, No. 10.
"Records of Indian Museum," Vol. 36,

Pt. II. Report on a Collection of Cestodes from Lucknow, by L. N. Johri, Vol. 37. Pt. II, on Teratodes from Wild Ducks in Rangoon, by B. S. Gogate.
"Science Progress," Vol. 29, No. 14.
"Review of Scientific Instruments," Vol. 5, No. 9.
"The Indian Trade Journal," Vol. CXIV, Nos. 1478, 1480.
"Indian Journal of Veterinary Science and Animal Husbandry," Vol. 4, Pt. 3, Sept. 1934.
"Arkiv för Zoologi," Band 26, Häftes, 3 and 4.
"Coffee in 1931 and 1932"—Economic and Technical Aspects. Issued by the International Institute of Agriculture, Rome.
"Forest Research in India, 1933—34," Pt. I. Issued by the Forest Research Institute, Dehra Dun.

Reviews.

ACTUALITÉS SCIENTIFIQUES ET INDUSTRIELLES. (Hermann et cie, Editeurs; Paris, 1934. Nos. 115, 116, 141 and 162.)

The first three numbers belong to the "Exposés d'Astronomie Stellaire" series and the last to the "Exposés de Physique Moléculaire" series.

1. No. (115). *Histoire de l'Astronomie stellaire jusqu'à l'époque contemporaine*, par H. Mineur (pp. 1-57).

This is the first of the series relating to topics on Stellar Astronomy and is meant to be a historical introduction. The author has very wisely confined himself to the statistical portion of Stellar Astronomy dealing with movements and distribution, leaving Stellar Physics to be dealt with under another series. Even with this limitation the subject is so vast that success in presenting a clear and comprehensive exposition must be really considered an achievement. The author who, along with Oort and Lindblad, has done distinguished work on the subject of the rotation of the Galaxy has been eminently successful in presenting such an exposition in the short space of fifty-seven pages. The author's aim has been not to give a mere chronicle of dates or a catalogue of figures but to present "l'état actuel de la science, ses méthodes et ses documents". The amount of information contained in and the variety of topics treated by this little book are truly astonishing. The author even finds space to present a clear account of the activities of the I. A. V. and it is interesting to read in this connection that "Dans les votes administratifs, chaque pays a un nombre de voix proportionnel à sa population, mais dans les

votes sur les questions scientifiques, chaque astronome présent dispose de sa voix".

On account of the vastness and rapid growth of the subject it would naturally be easy to pick out here and there a few topics not treated by the author. It might thus be pointed out that mention is nowhere made in the book of novæ and planetary nebulae, but perhaps the author thought that these are not of much statistical significance although important from the point of view of stellar evolution according to Milne's theory. In dealing with Shapely's cosmological scheme of supergalaxies and metagalaxies mention could have been made of estimates relating to the size of the galaxy and how the trend of recent work in this connection (see, for example, Plaskett & Pearce, *M.N.R.A.S.*, June 1934) is towards a reversion to Shapley's original ideas. Again, the work of Kapetyn and Strömberg on star streaming is given in bald outline without any attempt at clothing it with the flesh and blood of the relevant theory.

It must be admitted, however, that these are all trivial lacunæ in an otherwise excellent book which is so modern in outlook. The book contains two excellent photographs of Kapetyn and Shapley and other maps locating the important observatories of the world. One would have liked to see also a photograph of Herschel who is justly considered the father of Stellar Astronomy. A striking feature of the book is the original idea of the author of indicating the progress of astronomy during the centuries by means of a number of graphs in which the abscissa are the dates and the ordinates are the logarithms respectively of the number of

catalogued stars, number of proper motions determined, radial velocities, measured parallaxes and known variable stars at each epoch.

2. (No. 116). *Éléments de statistique Mathématiques*, par H. Mineur (pp. 1 to 40).

While the previous volume serves as a general introduction to statistical astronomy, the present one is intended to be a sort of mathematical introduction. While there is nothing in this book which would be new to a professional statistician, it is bound to be of the highest value to workers in stellar statistics and in other experimental sciences where mathematical statistics is applied. This is in fact the aim of the book and by the choice of particular examples from astronomical topics like stars of different absolute magnitudes and the correlation between spectral type and absolute magnitude, the author has succeeded in making the subject very intelligible. We only wish that there were more examples of this type especially in the later part of the book dealing with the characteristic function of a law of distribution and the application to integral equations. A specific example, chosen for example, from Seare's work on the density and luminosity functions would have added greatly to the clarity of exposition. The author's remark on the use and abuse of the law of Gauss, *viz.*, "La loi de Gauss ne doit être utilisée comme un moyen que si elle est applicable au problème étudié, mais rien *a priori* ne doit faire admettre qu'une loi de répartition inconnue est une loi de Gauss. L'oubli de cette remarque, pourtant si élémentaire, pourrait conduire à des résultats sans valeur" deserves to be widely known. The representation of a distribution by the sum of two Gaussian laws and an application of this to a particular case met with in stellar movements are particularly well treated.

It is perhaps true that the information contained in this book may not be sufficient to workers in statistical astronomy, but there is no doubt that it is necessary and indispensable.

3. (No. 141). *Photographie Stellaire*, par H. Mineur (pp. 1-67).

The two previous numbers of the series were more or less of a general nature; but in this volume the author considers the definite problem of explaining the methods of stellar photography for the determination of the positions and magnitudes of stars. Determination of stellar positions by photography covers less than one-third of the book and contains the usual methods of calculation of

the constants of a plate and the reduction to celestial coordinates. There is, in addition, valuable information regarding practical details of stellar photography and stellar images.

The remaining two-thirds of the book dealing with stellar photometry is easily one of the best connected accounts of the subject which the reviewer has seen explained in such a short space. Visual photometry is first dealt with very briefly and includes Pickering's meridian photometry culminating in the Revised Harvard Photometry and mention is also made of several catalogues of visual magnitudes, specially the Bonner Durchmusterung. The fundamental methods of photographic photometry, like the method of comparison with a sequence and other methods depending on the production of stellar images with known difference of magnitudes, are then explained. A study is then made of specially important sequences like the north polar sequence, Kapetyn's selected Areas and the Harvard sequences of Miss Leawitt. Mention is next made of the important photometric catalogues. A very interesting calculation of the limiting magnitude of a star visible in an instrument is given and is perhaps due to the author himself. The book ends with a short account of the method of extrafocal images and the ocular circle.

A rather significant omission noticed is the photometry of nebulae, galactic and extragalactic. The photometry of extragalactic nebulae has received a good deal of attention in recent years principally from the point of view of the integrated magnitudes, visual and stellar. But it is perhaps unfair to ask for more when the author has given so much of excellent and up-to-date information. For any one who wants to study stellar photography and "know what it all means" there is no better book that can be recommended. A list of contents and a short index would have added greatly to the value of the book.

4. (No. 162). *Travaux récents sur les molécules dans le soleil, les planètes et les Étoiles*, par P. Swings (pp. 1-44).

This book, which belongs to the series of monographs on molecular physics, is a natural sequel to the author's previous book in the *Actualité* series No. 50 entitled "Les bandes moléculaires dans les spectres stellaires". This appears to be the reason why one does not find here a treatment of the general theory of the subject involving principles

reduction
in addi-
g practical
nd stellar

the book
easily one
the subject
plained in
ometry is
d includes
lminating
metry and
analogues of
e Bonner
l methods
he method
and other
duction of
erence of
A study is
sequences
Kapetyn's
quences of
ade of the
s. A very
ng magni-
tment is
uthor him-
t account
es and the

iced is the
and entra-
tra-galatic
f attention
he point of
es, visual
fair to ask
on so much
formation.
dy stellar
all means"
be recom-
hort index
e value of

ur les molé-
les Étoiles,

ne series of
is a natural
book in the
es bandes
stellaires".
y one does
he general
principles

and technique. It consists of a connected account of recent work done in this field mainly between 1932 and 1934 and presents information properly "baked and cooked and served hot from the oven". Molecular bands in the solar spectrum cover four pages, spectra of planets about five pages and the rest is devoted to stars on the main sequence of classes F-G-K-S-M. A very clear account of the work on Carbon stars, specially the work of Rosenfeld and Wurm is given in a separate section. Mention is made in this connection of an interesting application of Schrodinger's wave functions to determine the relative intensities of bands of different groups in the spectra of C_2 and CN. The book ends with an exposition of the very recent memoir of H. N. Russel (*Astrophysical Journal*, April 1934, p. 317) on molecules in the sun and the stars. The results of this memoir are compared with the earlier work of Rosenfeld and shown to be an improvement on it.

The book contains a table of contents and a very valuable bibliography. It should be indispensable to workers in this field giving as it does a coherent summary of all the memoirs included in the bibliography.

B. S. M.

IONS, ELECTRONS AND IONISING RADIATIONS. By J. A. Crowther. (Edward Arnold & Co., London. Sixth Edition, pp. xii+340, 1934.) Price 12s. 6d. net.

The popularity of this well-known text-book is amply evidenced by the appearance of the sixth edition. Although larger text-books have now appeared, the book still fulfils a want and that well: it provides an introduction to the modern advances in physics that is at once simple, comprehensive and free from abstruse mathematics. The new edition is an improvement upon the last which appeared in 1929: two new chapters on "Neutrons, Positrons and Cosmic Radiation" and "The Structure of the Nucleus" have been added. The value of the book is enhanced by a set of problems at the end. The rest of the book has also been revised and many parts re-written and re-arranged, while a number of sections has been omitted as no longer interesting. Amongst the new information added all controversial points are left out as they ought to be, but the advantage of assuming only neutrons and protons with α -particles but no free electrons in the nucleus from the point of view of the mass defect curve might have been described.

An account of induced Radioactivity discovered by Curie and Joliot and extensively studied by Fermi and his co-workers might also have been given. Among the excisions we should have liked a few descriptions of experimental work to have been retained such as Langevin's method of finding the mobility of ions, or Townsend's experiments on the determination of the electronic charge, since they are instructive and interesting from a historical point of view. Apart from these minor details, the book in its new form gives an up-to-date account of most of the important fields of modern physical research and may be warmly recommended to all those who are beginning a serious study of modern physics after a tolerably good acquaintance with classical physics.

PERKIN AND KIPPING'S ORGANIC CHEMISTRY. Parts I, II and III. By F. S. Kipping and F. B. Kipping. (W. and R. Chambers, London.) Parts I and II in one volume, 614 pp. reprinted in 1933. Price 8s. 6d. Part III separate volume 615-967 pp. 1st edition 1934. Price 6s.

Parts I and II deal mainly with general systematic organic chemistry maintaining throughout a careful balance between theory and practice. The presentation and the scope of the subject are admirably adapted to serve as a very useful text-book for students preparing for a pass degree examination. Some of the subject-matter in small type and also the chapters XXXVII-XL as suggested by the authors are to be omitted from the pass degree course. The volume gives in detail the preparation of about eighty compounds many of which are ordinarily prepared by students during their course of practical work and as such avoids the necessity for buying a separate text-book of practical organic chemistry. The numerous editions undergone by this text-book during the past forty years speak for its continued popularity as an admirably adapted text-book. However, for students preparing for an Honours degree the matter is inadequate and necessitates supplementation. The authors will do well to adapt these two parts for pass course only and for such an adaptation the following alterations are suggested:—The Chapters XXXVI to XXXIX both inclusive might be condensed into one chapter under the heading 'Important components of animals and plants' and treat in a very elementary

manner alkaloids, terpenes, proteins, purine derivatives, pigments, vitamins, etc., so that the student can have just an idea of the scope and importance of the subject. The chapter on dyestuffs also is to be recast so as to give the student a mere outline of the nature and types of dyes and their variation in colour with structure.

Part III which is recently written as a continuation of Parts I and II is intended mainly for students preparing for Honours degree examination. This part which deals with special and advanced topics like stereochemistry, electronic formulae of organic compounds, terpenes, carbohydrates, etc., gives a very good description including the recent and up-to-date investigations. However, as it stands the part is inadequate for the standard for which it is intended. To make the volume a really useful text-book for Honours course the authors will do well to effect the following changes. This volume may be divided into two parts the first dealing with general organic chemistry and the second with Natural products. Then the Chapters XLI—L and LVII—LXI will have to be included in Part I. Heterocyclic compounds are to be elaborated and chapters on synthetic dyes and drugs added. Part II will then include Chapters LI—LVI. The Chapter LVI is to be treated in a more elaborate manner under different heads, *e.g.*, Plant Pigments, Vitamins, Hormones, Proteins, etc. Chapters on alkaloids and purine derivatives are to be added. With these alterations this volume becomes a very useful text-book for Honours course.

H. S. J.

* * *

NITROCELLULOSE ESTER LACQUERS: THEIR COMPOSITION, APPLICATION AND USES. By Dr. Fritz Zimmer. Translated by H. K. Cameron, B.Sc., Ph.D., F.I.C. (Chapman & Hall. 246 pp.) Price 18s.

Judging by the present state of Chemical Industry in India, it is doubtful if the production of modern Nitrocellulose Ester Lacquers will ever become a problem to her technical men; but their application and uses are, as indicated in the book, so wide and growing so rapidly even in this country, that its study will greatly help the technician.

The author is the chief chemist and technical director of a large paint works in Germany with a quarter of a century of experience in the field and has, as pointed out by the translator, produced an essentially practical book. It is difficult to think of any work which gives such a condensed and vast amount of detailed-technical information on the production, application and uses of the material described, namely, nitrocellulose ester lacquers. The manufacture of nitrocellulose, the properties of solvents, diluents, plasticisers, gums and resins and pigments which go to make the finished lacquer are all dealt with in sequence and with thoroughness. The method of application and the various uses to which they may be put are indicated. A description of plant used in the manufacture of the lacquer and various appliances used in their application are also included.

It would be ungrateful to complain where so much that is good has been offered; but a comparative estimate of cellulose acetate lacquers could well have been included. An error in the structural formula of diacetone alcohol on p. 21 may also be corrected in a future edition.

The publishers and the translator deserve to be thanked for putting such a valuable book in the hands of the English-reading public.

M. RAJAGOPALAN.

Errata.

Vol. III, No. 4.

Page 153, column 2, line 6 from bottom, read "The Band Systems of CaCl_2 " for "The Band Systems of CaCl ".

Page 154, column 1, line 4, read " CaCl " for " CaCl_2 ".

Page 159, referring to the magnifications

under the figures 4, 5, 6, 7, 8, 9, 10, 11 and 12.

read	× 620	for	× 310
"	× 780	"	× 390
"	× 173	"	× 86.5

Chemical
ul if the
ose Ester
em to her
tion and
, so wide
country,
help the

mist and
works in
century of
s pointed
essentially
think of
condensed
-technical
pplication
, namely,
ne manu-
ties of sol-
and resins
e finished
ence and
of appli-
hich they
escription
re of the
ed in their

tain where
fered ; but
se acetate
included.
ormula of
y also be

or deserve
valuable
sh-reading

OPALAN.

, 9, 10, 11

310

390

86.5

by
Bangalore.